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The Belltower

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About The Belltower

The Belltower, an interdisciplinary academic journal, publishes original undergraduate scholarly works written by Allegheny College students. We accept submissions from any academic discipline and from the Speaking and Writing Seminars (SWS courses). Submissions should be informed by critical conversations relevant to the topic and incorporate timely, pertinent research to support claims.

The Belltower does not publish creative literary works (poetry, fiction, creative nonfiction), news, or opinion articles.

The Belltower is published in academic semesters when ENGL207: Editing & Publishing is offered.

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The Belltower

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2026 Dieter P. Lotze Memorial Essay Prize

Editors' Introduction

Isaiah Deegan '28, Nadia El Bouatlaoui '28, Argyle Lindsay '27,
Gracie Miller '27, Mindy Mulligan '26, Michael Owens '28,
Callan Patterson '28, Addison Schaad '28, Grace Wilson '28,
& Megan Zimmerman '28

It is with great honor that we, the editors of *The Belltower*, introduce the first ever issue, which you are reading thanks to the cumulative effort of our talented Allegheny undergraduate author-researchers and our editorial staff, who labored to ensure that the intellectual work of these authors was handled with care. When we began our work on *The Belltower*, the journal was little more than an idea introduced and promoted by Professor Alexis Hart, who had aspirations not only to publish students' academic writing and set an example for future students but also to encourage professors to add the articles to their class reading assignments.

Our editing team first came together in the English 207 Editing and Publishing class. Over the course of the Spring 2026 semester, we individually honed our editing skills by completing *Chicago Manual of Style* online quizzes (or "workouts" as they're referred to) and more detailed practical copyediting exercises, researching and delivering informative presentations and composing critical arguments, and hearing from guest speakers about their experiences in the industry. Once we familiarized ourselves with the world of publishing, we collaborated as a class to produce a *Belltower* style guide to ensure consistency in document design, spelling and capitalization, citation format, etc. Our experience was shaped by the entire publishing process–teamwork, communication, revision, and practice. All of this preparation culminated in our final task: each of us worked with an author to edit a manuscript for publication in *The Belltower*. After countless hours of effort inside and outside of our Editing and Publishing class, we have created a journal that we take pride in.

As you will see, the authors are deeply passionate about their subjects. Their voices deserve to be heard, and their hard work deserves recognition. While Allegheny College has a long history of publishing *The Allegheny Review*—a national undergraduate literary magazine that focuses on fiction, creative nonfiction, and poetry—until *The Belltower* came to fruition, no similar campus publication existed for Allegheny students desiring to publish their scholarly writing. *The Belltower* now provides a worthy home for interdisciplinary student research at Allegheny and reflects the college's mission of promoting a liberal arts education by encouraging all readers to think critically and creatively about diverse topics.

This inaugural issue of *The Belltower* includes nine articles from across the disciplines and features Nickel Spartz's essay "Circumlocution: The Applicability of a Language Strategy to STEM Fields," which was awarded the 2026 World Languages and Cultures departmental Dieter Lotze Prize.

Volume 1 begins with Alanna Blose's essay delving into the poems of Walt Whitman and Mark Doty, "Transfiguring Taboo into the Sacred: The Poetic Reclamation of Desire and the Body," in which Blose explores the way poetry can challenge the way we view what is sinful and

what is sacred. Her study of these authors shows how they condemn the separation of spirituality and desire and how they encourage us to embrace the divinity of our bodies. In "Are AI Chatbots Epistemically Reliable?" Liam Irving contends with the question that many of us are currently pondering: how trustworthy is AI? Irving is systematic in his analysis and explores the logic programmed into artificial intelligence, as well as the implications of (over)relying on AI chatbots for information. Samuel Ault's article, "Epistemic Responsibility in the Face of Ignorance: The Failure of Internalism to Appropriately Account for Instances of Implicit Bias and Active Ignorance," criticizes the philosophical concept known as internalism because it allows individuals to justify their ignorance, biases, and microaggressions. Ault argues that internalism should be disavowed to encourage people to take responsibility for their ignorant actions and thereby decrease discrimination or prejudice. Mckenzie Hughes seeks to explore how culture is co-opted and used as a tool of division in her article "Factors That Facilitated the Holocaust," focusing on the rise of the Nazi regime. Hughes blends cultural and political history to tell the story of how the Nazi co-opted Germanness and facilitated the Holocaust. In her article "Political Friendship," Reagan-Grace Wheat asks: Is political friendship the key to bridging partisan gaps? Through critical analysis and deep research, Wheat considers how friendly conversations can aid political discourse and applies her knowledge about political partisanism to create a card game that can help facilitate such conversations. Alyssa Gent highlights the use of MAT (Medication-Assisted Treatment) as a way to fight off addiction to substances such as alcohol and drugs in "Medical Assisted Treatment as a Vehicle to Sobriety." Gent focuses on the biology informing MAT as well as the many benefits of undergoing the treatment. In addition, Gent also considers the side-effects and negative qualities of different methods. Samuel Roque's article, "Sickle Cell Disease," is written in the form of a speech and seeks to encapsulate the emerging solution of gene therapy to treat sickle cell disease. Roque highlights the successes and the limitations associated with the dissemination and results of the treatment, arguing that hefty prices should not prevent people from receiving crucial medical care. In their co-authored article, "Understanding Imperfection: A Spectroscopic Study of Rare Earth Gemstones," Jonah Wells and Tanner Pilarski research the physical and chemical properties of crystals and lead readers through their process of understanding and identifying what causes defects in the crystals they analyzed. Wells and Pilarski also investigate rotational symmetry and absorption behaviors of crystals, bringing light to why color centers of the crystals change according to their environments. In the final article of Volume 1, "Getting to the Point: The Development of the Javelin," Jonah Wells combines his knowledge of physics with his passion for javelin—a track and field sport—to explore the history of the javelin, its roots in ancient Greece, and how the sport has changed for modern day Olympics. Through his research, Wells delivers an insightful look into the physical principles behind the flight of a javelin and highlights how it is undergoing constant change and introduces the possibility of further adaptation of both the tool and the sport in the future.

It is through the enthusiasm, determination, and perseverance of our community that the idea that once was *The Belltower* has come to fruition, now a real, fully-fledged academic journal that we have the pleasure of sharing with you. We'd like to thank Professor Alexis Hart, without whom this journal would not be possible, for allowing us the opportunity to hone our editorial skills, build valuable connections working alongside our peers, and be a part of something that will last long

after we've graduated from Allegheny. We extend our thanks to students in the Fall 2025 Editing and Publishing course who gave the journal its name and helped pave the way for the successful launch of the first volume. Thanks, too, to the library staff who helped us to secure the Creative Commons licensing agreement and assist us with making the journal discoverable beyond Allegheny's campus. To our contributing authors, thank you for trusting us with your work and having the courage to let your voices be heard. Finally, thank you to our readers; it is your interest and commitment to supporting the creative minds of Allegheny that gives us the strength to continue. It is our hope that as you are reading, you feel inspired to share your own voices with us.

Transfiguring Taboo into the Sacred: The Poetic Reclamation of Desire and the Body | Walt Whitman and Mark Doty

Alanna Blose

This work examines how Walt Whitman and Mark Doty reconstruct the concept of the sacred by repossessing taboo subjects–particularly the body, sexuality, and queer desire–as habitation of spiritual meaning. Harnessing longstanding Western traditions that divide holiness from physical experiences, both poets collapse the boundary between the sacred and the profane. Through close readings of Whitman's *Leaves of Grass* and Doty's "Homo Will Not Inherit," the essay argues that Whitman elevates the body and sensuality as inherently divine, while Doty transforms excluded queer spaces and experiences into domains of spiritual power. Whitman's unyielding poetic voice sanctifies touch, embodiment, and homoerotic desire as expressions of universal divinity, whereas Doty reclaims stigma and reimagines primal hunger through religious imagery, presenting intimacy as ritual and birthright as rooted in the margins. Together, their works articulate a radical spirituality grounded in lived, embodied experience rather than abstract doctrine. Ultimately, the essay finds that both poets invite audiences to reconceive holiness as immanent—present within the living sanctuary, longing, and connection—rather than as distant or transcendent.

Keywords: Walt Whitman, *Leaves of Grass*, Mark Doty, sacred, taboo, sexuality, queer identity, body, desire, spirituality, homoeroticism, marginality

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The concept of the sacred is traditionally thought of as transcendent, otherworldly, and detached from the fleshly, the sensual, and the erotic. For centuries, Western religious and moral systems have relegated the body, sexuality, and desire to the realm of sin, subjecting them to shame and silence. Yet in the works of Walt Whitman and Mark Doty, the taboo—the subjects that society often represses—is not merely acknowledged, but sanctified. In their poetry, Whitman and Doty challenge the boundaries of holiness and transfigure the profane into the sacred. They offer a radical redefinition of spirituality that does not distance itself from the body but instead elevates it, placing human experience at the center of divine truth. Their works invite us to reconsider long-held beliefs about sin and sanctity, urging us to see the holiness in human desire, intimacy, and our physical bodies. Through their lyrical reclamation of taboo subjects, Whitman and Doty imply that divinity does not lie beyond the flesh but is embedded in its very existence. Their poetic transformations invite the "talkers'—the ones who have long adhered to conventional moral and religious codes—to understand that the sacred and the profane are not opposing forces, but are intertwined and coexistent within the human experience.

Whitman powerfully affirms the sacredness of the body as a central theme in his poetry. Walt Whitman's *Leaves of Grass* represents a radical departure from traditional portrayals of the human body in poetry. Whitman, in his refusal to separate the body from the soul, transcends the separation between the sacred, asserting that the body itself can embody the divine. His revolutionary approach is most evident in his celebration of the male body, particularly in its natural, uninhibited state. In "Song of Myself," Section 24, Whitman boldly declares, "The scent of these armpits aroma finer than prayer, / this head more than churches, bibles, and all the creeds" (Whitman, Lines 525-526). In these lines, Whitman shifts the foundation of holiness from the abstract and spiritual to the tangible and physical. The "aroma" of the human body, traditionally seen as something base or revolting, is elevated to a state of divinity that surpasses religious symbols like prayer or scripture. By comparing the scent of his armpits to the sacredness of prayer, Whitman challenges the Christian model that positions the body as something to be ashamed of, suggesting instead that it is the very source of spiritual truth.

Whitman's vision of the body as divine continues throughout "Song of Myself," when he proclaims, "Divine am I inside and out, / and I make holy whatever I touch or am touch'd from" (Whitman, 524). Here, Whitman presents a radically inclusive spirituality—one that sees no separation between the sacred and the physical. By proclaiming that he "makes holy" whatever he touches, Whitman erases the line between the pure, proposing that divinity is found not in repression but in the embrace of our physical, sensual existence. The very act of touch becomes a sanctifying force. In this vision, physical contact is not a corruption of holiness, but its very conduit.

Whitman's embrace of sensuality and the body also includes an exploration of homoerotic desire, a theme that was quite taboo in his time. In Section 11 of "Song of Myself, " Whitman offers a sensual narrative involving twenty-eight young men bathing, observed by a lonely woman. He writes: "Which of the young men does she like the best? / Ah, the homeliest of them is beautiful to her" (Whitman, 204-205). Rather than portraying the woman's desire as improper or voyeuristic, Whitman presents it as an honest and human emotion, emphasizing that the true beauty of the young men lies not in their external appearance but in the emotional connection they offer. This passage suggests that the woman, rather than being a passive observer, is invited to recognize the deeper emotional and spiritual qualities that transcend physical beauty—qualities that Whitman elevates to the sacred. Rather than focusing on her external desires or objectifying the men, she is called to perceive their inherent beauty and to engage with them on a level of shared humanity and connection. This scene transforms eroticism from a sinful act into one of deep connection and beauty, placing it on a sacred throne. Through this radical representation, Whitman sanctifies love and intimacy as expressions of an inner truth.

In the Calamus cluster of poems, Whitman continues to explore homoerotic love, treating it not as a deviation from the norm, but as a vital and sacred form of connection. In "Scented Herbage of My Breast," Whitman writes, "Come I am determin'd to unbare this broad breast of mine, / I have long enough stifled and choked" (Whitman, 21). The act of "unbaring" his chest can be read as Whitman's longing to reveal his suppressed queer identity, to openly embrace love that has been snuffed by societal norms. The "broad breast" metaphor suggests a yearning for spiritual liberation through the acceptance of one's true, known self.

While Whitman sanctifies the body as a site of identity, channeling forbidden desires into acts of spiritual revelation, Mark Doty's poetry similarly dances with themes of sexuality and desire—but shifts the focus toward the reclamation of queer spaces and the transformation of marginalization into a site of spiritual power. In his poem "Homo Will Not Inherit," Doty responds to a homophobic sign that reads, "HOMO WILL NOT INHERIT. Repent & be saved" (Doty, 21). Rather than succumbing to the shame implied by the sign, Doty subverts its meaning by reimagining what it means to inherit: "I'll tell you what I'll inherit: the margins / which have always been mine, downtown after hours / when there's nothing left to buy" (Doty, 22-24). For Doty, the "margins" are not a place of shame, but of identity and power. The space that society has relegated to the periphery becomes, in Doty's vision, sacred land, his Jerusalem. It is here—on the fringes of mainstream society—that queer desire is free to bloom, unpoliced and unjudged. Doty reclaims the so-called "taboo" spaces of queer experience, transforming them into realms where truth and authenticity reside. As Whitman transforms the erotic, found in his tender depictions of male intimacy, the physicality of the body, and sensual connection to nature, from something culturally taboo into a sacred expression of identity and selfhood, Doty builds on this legacy, redefining inheritance, asserting that the sacred is not found in the traditional or the accepted, but in the margins where desire and identity converge.

Doty's use of religious imagery to describe queer intimacy echoes Whitman's own transformation of the erotic into the divine. In "Homo Will Not Inherit," Doty writes, "I've seen flame flicker around the edges of the body, / pentecostal, evidence of inhabitation. / And I have been possessed of the god myself, / I have been the temporary apparition / salving another, I have been his visitation, I say it / without arrogance, I have been an angel" (Doty, 40-45). Terms like "pentecostal," "possessed of the god," and "angel" invoke Christian imagery typically associated with divine intervention, but Doty redirects this language toward the erotic. Desire becomes not just an earthly experience, but a divine one—an act of spiritual possession, healing from trauma, and transformation. Through this reimagining, Doty asserts that the body is a vessel of divinity, and the touch of a lover is as sacred as any religious ritual.

In a similar vein, Doty explores the sacred nature of physical intimacy in "Homo Will Not Inherit": "after we'd been, you understand, / worshipping a while in his church, / he said to me, I'm going to punish your mouth. / I can't tell you what that did to me" (Doty, 82-85). Doty takes what might be seen as a taboo act, BDSM, and reimagines it as a form of worship. The church is not a building, but the lover's body, and the act of intimacy becomes a sacred ritual. The language of "punishment" is transformed into an act of spiritual communion, further blurring the line between the blasphemous and the sacred.

Doty's poetic exploration of spirituality culminates in his rejection of conventional salvation. He writes in "Homo Will Not Inherit," "The spirit's transactions / are enacted now, here—no one needs / your eternity" (Doty, 89-91). Similar to Whitman, for Doty, salvation is not a distant promise for the afterlife, but a present reality. It is in the immediate, embodied experiences of desire, connection, and intimacy that divinity can be found. Like Whitman's assertion in the opening of "Song of Myself "—that the sacred begins with the self, in the now, in every atom, as seen in his celebration of the body and lines like "If I worship one thing more than another it shall be the

spread of my own body" (Whitman 527)—we see in Doty a similar conviction: that the sacred is not conditional or deferred, but present in our bodies and our desires, as in "Homo Will Not Inherit," where physical intimacy becomes a form of worship and the erotic is framed through reverent, almost ritualistic language.

Both Whitman and Doty engage in a radical reclamation of the taboo. They transform what society has long regarded as sinful into art of the divine. For Whitman, the body is the sacred vessel, and through it, spirituality is achieved. For Doty, the margins of society, often seen as corrupt or degenerate, become the very spaces where the sacred is realized. In their poems, both poets reject the conventional split between the blessed and the vulgar. Instead, they invite us, taking our hand, to see that holiness is not to be found in repression, but in the warmth of human hunger and need. By sanctifying the taboo, both Whitman and Doty offer a vision of spirituality that is deeply aligned. The divine is not a distant abstraction but something present in the physical world, in our relationships, and in the very simple act of touching another person. Their poetry challenges the moral codes that have long sought to separate the sacred from the erotic, urging us to see divinity not as something external, but as something deeply embedded within us—beneath our skin, pulsing through our veins, and coursing into the very core of our being.

Whitman's and Doty's works offer a profound reimagining of what it means to be holy. Through their lyrical treatment of taboo subjects—sexuality, the body, queer love—they clash conventional notions of sin and sanctity, urging us to embrace the sacredness inherent in our physical selves. By transforming desire and intimacy into acts of spiritual power, both poets provide a radical alternative to religious traditions that have long sought to repress the body and its desires. Their work invites readers to rethink the very nature of holiness—not as something distant, or beyond us, but as something internal, present, and within our very grasp. The sacred, in their view, is not a realm beyond the flesh—it is here, in the flesh, in the body, in the love we give and receive, and in the spaces where society least expects to find it.

References

Doty, Mark. 1995. *Atlantis: Poems*. New York: Harper Perennial.

Whitman, Walt. 2004. *Walt Whitman: The Complete Poems*. Edited by Francis Murphy. Penguin Classics.

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and writing with greater intention. This experience has transformed how I understand language and expression as a whole.

I am also deeply grateful to Addison Schaad, whose guidance was instrumental in helping me navigate the publication process, which was entirely new to me. With her support, I learned to trust my voice, along with others, and embrace revision as a necessary part of growth rather than a setback. The challenges I encountered throughout this process pushed me beyond my comfort zone and strengthened my confidence as a writer. What once felt unfamiliar and intimidating gradually became an opportunity for development, allowing me to evolve in both technical and creative areas of writing. Without this experience, I would not have discovered the extent of my own potential.

Lastly, I would like to thank my family, who have supported me unconditionally through every stage of my journey. Their constant encouragement has given me the foundation to pursue my passions with confidence. They have taught me to find meaning in the ordinary and to appreciate the quiet, often overlooked moments that undoubtedly shape our lives. Because of them, I have grown not only as a writer but as an individual, someone who seeks depth, beauty, and understanding in the world around me. Their presence has been my source of inspiration, reminding me that my growth is about perspective, connection, and the ability to see the extraordinary within the everyday, not only about achievement.

Are AI Chatbots Epistemically Reliable?

Liam Irving

This paper examines whether large language model (LLM) chatbots can be considered epistemically reliable sources of information. While there is a substantial body of work on epistemic trust and testimony, and recent discussions on the computational reliability of AI, we lay the groundwork for the epistemic implications of LLMs. Drawing on theories of epistemic trust, this paper argues that AI systems cannot qualify as knowers because they lack belief. Instead, their outputs are best understood as artifacts produced through pattern recognition. We evaluate reliability using four criteria: locality, track record, independent verifiability, and expert knowledge. While LLMs often meet the first three conditions, they fail to satisfy the fourth requirement, as their responses are not based on understanding. The paper concludes that while careful epistemic practices remain unchanged, widespread reliance on AI without scrutiny introduces new risks of misinformation and epistemic dependence.

Keywords: artificial intelligence (AI), Large Language Models (LLMs), epistemic, trust, reliability, chatbots

Large language models (LLMs) often achieve impressive accuracy under training conditions, but have the potential to fail in spectacular and unexpected ways when they are deployed in real-world settings. With the growing prominence of artificial intelligence (AI) technology in the layperson's life, I pose the question: Are AI chatbots epistemically reliable?

To first answer whether or not AI bots are reliable, we have to set some parameters for clarity. First of all, an LLM is a machine learning model that uses AI to process and generate language that mimics human speech (examples include Google Gemini and ChatGPT, but not narrow AI models like IBM Deep Blue, which is used for chess). Secondly, we need to establish what makes something reliable. Reliability is not merely a measure of performance, but a philosophical concept tied to how we justify our beliefs, and how we determine who or what counts as trustworthy sources of knowledge. Philosopher John Hardwig (1991) argues that the role of trust in knowledge is as follows:

> *A knows that B says that p. A believes (and has good reasons to believe) that B is speaking truthfully, that B is saying what she believes. A believes (and has good reasons to believe that B (unlike A) is in a position, first, to know what would be good reasons to believe p and, second, to have the needed reasons. A believes (and has good reasons to believe) that B actually has good reasons for believing p when she thinks she does.*

If that gives you a headache, and you need to read that over again: Hardwig is basically saying that in order for you to trust what someone else says, they must be in a good position to know and also must fully believe what they say. With this role of trust, we can replace A with you

and B with ChatGPT. We, quite quickly, run into problems. For one thing, the LLM isn't speaking (even when it approximates a human voice). Every response is built from a formula of 1's and 0's, just like every other computer program. It is no different than when a calculator "says" the square root of a number, or when Google automatically fills out the rest of your search based on the first few words you type or speak. An LLM generates its output based on the mathematical relationships it has learned. Also, the bot doesn't "believe" anything, because it needs to think to believe, and, as far as we know, technology is not sentient. There's no need to discount AI as tools for knowledge just yet, because we can still view their responses as physical artifacts, rather than expert testimony. Now, all we need are those good reasons to believe what we see, as Hardwig says.

In order for a belief to count as a result of a reliable belief-forming process, it is necessary that the relevant output is reliable only in a local range of circumstances (Buijsman 2023). In other words: if you have a method for forming a belief, it can still be considered reliable even if it does not work perfectly in every situation. A thermometer may not work in extreme temperatures, but since it works in standard conditions, we still treat it as reliable. Philosophers Goldman and Beddor (2021) also claim that we are justified in trusting a model if it has a history of producing correct outputs. When it comes specifically to computational reliability, we also look for safeguards such as verification via formal methods and the role of expert knowledge (Grote et al. 2024). Using these methods, we can say that something is reliable when it meets these four criteria: it is correct in a local range, it has a history of producing correct results, it can be verified via other traditional methods, and it is based on expert knowledge.

Let's apply this to a real-world example. Say, for instance, I want to know when the first iPhone was released, so I ask two different models of AI:

(1)
Me: When was the first iPhone released?
ChatGPT: The iPhone was officially introduced by Steve Jobs on January 9, 2007, during a keynote address at the Macworld Conference & Expo in San Francisco. It was released to the public on June 29, 2007….

(2)
Me: When was the first iPhone released?
DeepAI: The first iPhone was released on June 29, 2007.

Now, we can use our rules to check if the responses were reliable. 1) We do know chatbots can be correct about widely documented facts—like the release of the iPhone. So they are reliable in the local range. 2) From personal experience, I have seen a history of chatbots producing correct results (from asking similar questions in my day-to-day life). 3) This information can be independently verified by Apple's own press release, and a third-party article from 2008. 4) Unfortunately, our advanced artifact only makes it so far with our reliability checklist. The most popular chatbots do not rely on expert testimony, but rather an algorithm. Think of it as a "most likely" game (Wolfram 2023). That is, the chatbot doesn't *know* June 29, 2007 is the date on which

the iPhone was first released; it has just "seen" that combination of words often enough to predict it accurately.

From this example and analysis, we conclude that while AI chatbots can be accurate and useful, they fail to meet two crucial standards of epistemic reliability: they do not understand or believe (so therefore cannot testify as knowers), and they are unreliable as artifacts without the basis of expert knowledge. What may this imply for epistemology as a whole? For people who are epistemically responsible, it shouldn't imply anything, since this won't change what they have been doing, and they may continue their previous practices. If you previously verified claims, cross-referenced evidence, and checked sources in the 2010s, why change anything now? But for the broader population, there is an epistemic vulnerability. If people uncritically accept information generated by AI, they may unknowingly internalize unreliable content. Worse, they may pass that content on to others who trust them as sources of information, creating a chain of dependence rooted in an unreliable foundation.

Although we have deemed chatbots as unreliable sources of information and artifacts, we can still use them as epistemic tools. Since we most recently concluded that the only rule they break as artifacts is expert testimony, we can still reliably use AI for tasks in controlled settings, where an expert is present, as Hardwig (1991) explains:

> *If B is not personally known to A, the strategy for attempting to ascertain the reliability of B is to get a second opinion about the truth of what B has said, as long as C is knowledgeable of p.*

Say, for example, I notice an unusual sound coming from my car. I ask an AI chatbot for a possible diagnosis. It suggests that the issue might be with the serpentine belt, so until I have further information, I conclude that to be the issue. Sometime later, I double check with my mechanic friend, who confirms the diagnosis. In that situation, the mechanic has epistemic authority, since I trust them as a reliable source of knowledge, but the chatbot was useful in getting me closer to the answer than I would have been on my own. It accelerated my thinking and gave me a plausible starting point. At that same exact point, though, the need for AI was no longer present, since I ultimately checked it with an expert whose testimony trumps any other source of information. So what was the difference between asking AI first and simply waiting for a reliable source to check with?

We don't use chatbots for the purpose of knowing everything, we use them for convenience! If someone genuinely wanted to become deeply knowledgeable about a subject, I hope they wouldn't rely solely on a chatbot. Instead, they'd ideally enroll in a class, consult other sources, or conduct other research. If I absolutely had to know what happened to my car, I would immediately ask the mechanic. That process of inquiry requires time and dedication. We've seen the strength of LLMs in helping users start a learning process or clarify practical matters. We already interact with many tools or people in this way. Think about how we trust certain individuals in our lives, not because they are the ultimate authority, but because they are reliably helpful within specific, limited domains. My mother never pursued a culinary degree, but I certainly trust her when she teaches me

a recipe. Much like a smart friend or reliable parent, we can confidently use AI to conveniently aid our knowledge in situations in which we wouldn't realistically be able to rely on experts.

On the outskirts of epistemology, we can reliably use LLMs to confirm spelling and grammar, because their architecture is inherently based on statistical language modeling. In high school, I realized that I could add incorrect punctuation or purposely misspelled words to bypass plagiarism detectors, and thereby use AI without being caught (fortunately, I found in college that they are epistemically unreliable). Unlike humans, who might overlook errors due to fatigue or distraction, chatbots consistently apply grammatical rules because they're literally programmed to do so. For someone like a student or non-native speaker struggling to find the right words, this makes AI an incredibly efficient editing tool. They have further use in the classroom, as well. For example, Wharton Professor Ethan Mollick states that teachers can use AI for creating explanations of course concepts:

> Coming up with lots of ways to explain a single topic can take a ton of time and effort. It can be hard figuring out how to pitch ideas at just the right level, include background info, and adapt for different learning needs. This is where AI can help out. AI can generate different explanations, walk through ideas step-by-step, and add in more examples. If some students are struggling, AI can provide simpler summaries to get them caught up.

In these situations, the key point is not whether AI "knows" what it's doing, but whether it performs reliably enough to support us in a given task. We don't consult it to replace expert instruction, we consult it when the stakes are low, the question is straightforward, or the answer is good enough to move us forward.

Ultimately, the widespread use of chatbots reflects a pragmatic adjustment to knowledge building. Whether that means checking a date, drafting an email, or finding out how long to boil pasta, the goal isn't perfect knowledge, but convenience. On that front, I *know* that AI delivers.

References

Buijsman, S. 2023. "Over what range should reliabilists measure reliability?" *NLM*, 1–21. https://pmc.ncbi.nlm.nih.gov/articles/PMC9811052/.

Goldman, Alvin, and Bob Beddor. 2021. "Reliabilist epistemology." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta, Summer 2021 edition. https://plato.stanford.edu/archives/sum2021/entries/reliabilism/.

Grote, Thomas, Kevin Genin, and Emma Sullivan. 2024. "Reliability in Machine Learning." https://philpapers.org/archive/HARTRO-3.pdf.

Mollick, Ethan. 2023. "Using AI to Make Teaching Easier & More Impactful." *One Useful Thing.* https://www.oneusefulthing.org/p/using-ai-to-make-teaching-easier.

Wolfram, Stephen. 2023. "What Is ChatGPT Doing...and Why Does It Work?" February 14, 2023. https://writings.stephenwolfram.com/2023/02/what-is-chatgpt-doing-and-why-does-it-work/.

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Epistemic Responsibility in the Face of Ignorance: The Failure of Internalism to Appropriately Account for Instances of Implicit Bias and Active Ignorance

Samuel Ault

Epistemic internalism fails to adequately address concerns about knowledge formation in cases of either active or passive ignorance. The core of internalism "is that the subject has to be thinking rationally, and making up her mind on the basis of evidence that is accessible to her" (Nagel 2014). Internalism suggests that, as knowers, we only have epistemic responsibility to consider the information that is cognitively accessible to us via reflection (Pappas 2023). However, this leaves the potential for ignorant and biased individuals to be counted as being justified in holding their ignorant and biased beliefs. Examples of both motivated ignorance and implicit bias demonstrate the moral repercussions of accepting internalism's cognitive accessibility clause. This clause forces adherents to accept that those who refuse to become aware of counter-evidence are justified in their prejudiced beliefs, even when they could have allowed themselves to be exposed to counter-evidence. This is an unacceptable consequence for any theory of knowledge; we would expect that a theory of knowledge would require us to consider a totality of the evidence, not merely what we are comfortable with. In this essay I will argue that contrary to the traditional doctrine of internalism, we must accept epistemic responsibility for at least some information that we are ignorant of (and therefore do not have cognitive access to). I argue that this moral and epistemic responsibility is specific to cases where ignorance is more than merely incidental, such as when it is deliberate or malicious.

Keywords: epistemic responsibility, internalism, implicit bias, ignorance

Epistemic internalism fails to adequately address concerns about knowledge formation in cases of either active or passive ignorance. The core of internalism "is that the subject has to be thinking rationally, and making up her mind on the basis of evidence that is accessible to her" (Nagel 2014). Internalism suggests that, as knowers, we only have epistemic responsibility to consider the information that is cognitively accessible to us via reflection (Pappas 2023).

However, this leaves the potential for ignorant and biased individuals to be counted as being justified in holding their ignorant and biased beliefs. Through examining instances of both motivated ignorance and implicit bias, I will demonstrate the moral repercussions of accepting internalism's cognitive accessibility clause. This clause forces us to accept that those who refuse to be aware of counter-evidence are justified in their prejudiced beliefs, even when they could have allowed themselves to be exposed to counter-evidence. This is an unacceptable consequence for any theory of knowledge; we would expect that a theory of knowledge would require us to consider a totality of the evidence, not merely what we are comfortable with. I will argue that contrary to the

traditional doctrine of internalism, we must accept epistemic responsibility for at least some information that we are ignorant of (and therefore do not have cognitive access to). I will argue that this moral and epistemic responsibility is specific to cases where ignorance is more than merely incidental, such as when it is deliberate or malicious. As such, I will reconcile internalism's concerns about what is cognitively accessible with the epistemic and moral considerations arising from ignorance and bias.

Internalists say that we have epistemic responsibility only for things that are cognitively accessible for us to know. For example, we cannot ignore counter-evidence that would make us unreasonable if we were to ignore it. However, it is coherent to say that we have epistemic responsibility for some things that we are ignorant of and therefore do not necessarily have definitive counter-evidence available for, because we sometimes make intentional choices to be ignorant or under-informed about certain topics. While it may be reasonable to object that it is unreasonable to assert that people are responsible for the evidence that they are not aware of, doing so would fail to hold people accountable for actions we would generally want to consider moral failures. Additionally, this epistemic responsibility for things we are not cognitively aware of applies in cases when the subject's ignorance is deliberate and/or malignant, such as a white person who does not listen to Black testimonies about the damage of microaggressions, for example.

Internalism is an epistemological theory that postulates that in order to count as knowing something or to count as being justified in believing something, you have to have a first-hand understanding of how you came to that conclusion. Unequivocally, internalists will agree that you know that nine times nine is eighty-one if you are capable of adding the number nine to itself nine times to get to eighty-one. One example of when an internalist might doubt that someone knows that nine times nine equals eighty-one would be in the case of some young student who heard their teacher say that fact, but cannot back up their belief with the requisite arithmetic. The competing philosophical theory, externalism, would actually count both situations as demonstrating knowledge because the speaker has an appropriate relationship to the truth, being able to deduce it on their own or having had it confirmed by a knowledgeable source (i.e., a source judged to be knowledgeable), based on some reliable process for determining if a source is credible. Jennifer Nagel (2014) explains that the crux of internalism "is that the subject has to be thinking rationally, and making up her mind on the basis of evidence that is accessible to her." In this view, for every potential piece of knowledge (and every belief they want to justify) the subject is supposed to decide that, yes, they do know what they believe themselves to know because they can say how they came to know that information (though the extent of justification required is a point of contention among internalists). Externalists are significantly less strict in how they define knowledge, going so far as to accept that you can have knowledge of something without necessarily having accessible evidence, relying instead on the idea of having an appropriate relationship to the truth. This term, "accessible," is where my criticism of internalism arises. "Accessible," in the internalism vs. externalism debate, commonly refers to the idea of something being "cognitively accessible," meaning that upon conscious reflection the subject can be aware of it.

I argue that we have epistemological responsibility beyond what is cognitively accessible to us, which may be contrary to many people's intuition. One could say that it is extremely

unreasonable to expect someone to take responsibility for something they are unaware of, but I will restrict this claim solely to times when someone ***could*** have had access to different, or more complete information. Epistemological responsibility is the idea of having to account for what you know and therefore also what you are ignorant of. It is the matter of ignorance that particularly concerns me. Ordinary ignorance that results from unavoidable circumstances or mere happenstance is insignificant to the conversation about moral and epistemological responsibility. Instead, I am concerned with two particular types of ignorance: active ignorance and ignorance that results from implicit bias. Active ignorance is ignorance that results from some sort of intentional choice: including choices to disregard information, avoid new information, and to seek out biased sources. Ignorance from implicit bias influences our beliefs and judgements and is formed instinctively or subconsciously. Implicit bias alone does not necessarily constitute ignorance or a problem for maintaining proper epistemic responsibility. Instead, the problem arises when we attempt to rationalize the biased initial judgements, we make without addressing the role of implicit bias—especially when we claim that we know our reasons for making a biased decision, at least when we fail to include implicit bias within those reasons. Even when we do acknowledge our implicit bias, if we are not entirely certain of the extent of those biases (which would make them no longer implicit in nature) we are still in epistemically unjustifiable territory.

If internalists are willing to say that someone has knowledge or justification based solely on the considerations within their already existing experiences, memories, and mental facilities, then what happens when we are lacking relevant information? This is of special moral concern when we lack information that we could have access to if we were to put in (more) effort. I think particularly of an example that concerns a white individual who makes a microaggressive remark, fails to notice the harm of said remark, and then decides that said remark was not harmful. The harm of that remark is not cognitively accessible to this white person; they can rationally and truthfully say no one began to bleed or cry or anything of the sort due to their remark, even if there were obviously interpretable signs of harm that they failed to accurately interpret. Of course, if the victim of said hurtful remark remained stoic, that does not necessarily remove epistemic responsibility for knowledge of the harm from the microaggressor. It may be reasonable to expect that individuals include the likely or possible effects of their words in considering potential for harm.

Now, an internalist would certainly argue that the microaggressor doesn't count as having knowledge of the nature of the microaggressive nature of their statement, because the speaker's belief is inaccurate. However, the problem arises when we ask if the speaker is justified in their belief that they did not commit a microaggression. Morally, we can assume that it is a failure to exonerate oneself from having committed a microaggression without learning from the experience or making amends. But through using internalism, we have to conclude that if the speaker evaluated all knowledge that is cognitively accessible to themself then they are justified in believing they did not commit a microaggression. Intuitively, it feels wrong to allow ignorance to exonerate someone, as evidenced by the fact that ignorance of the law is not a sufficient legal defense for transgressing against it. It therefore follows that we do not want an epistemological theory that allows us to use ignorance to exonerate ourselves from moral failures. Additionally, internalism not only allows for people to count themselves as justified in these sorts of situations, it provides no expectation or

particular route for that speaker to become aware of their lack of knowledge or the flaw in their justification. To be epistemically responsible is to have some obligation to consider some piece of information, to be morally responsible is to have some sort of obligation towards some sort of action or virtue. It seems that internalism is failing to hold us epistemically accountable for morally relevant pieces of information, like the harm that certain kinds of words or sayings can cause.

The issue with accepting solely information that is cognitively accessible to the subject as the basis for claims to knowledge/justification is that as subjects we have some degree of autonomy over what is cognitively accessible to ourselves: What information do we seek out? What information do we tune out? What information do we memorize, and what information do we allow ourselves to forget? These factors are situations over which we have some control; we could have chosen to memorize different information, we could have sought out stories that have been suppressed, and so on. All of this is further complicated because not only do we have to question why certain things are not cognitively accessible to us, but we also have good reason to doubt even that which is cognitively accessible to ourselves provides the full picture, due to the increasing scientific understanding of implicit biases.

For example, there is scientific evidence that people tend to have racial biases which may result in them thinking Black applicants are unsuitable for hiring (Abel and Burger 2023). When someone with an implicit bias against Black people reflects on their beliefs about who is hirable, they will have cognitive access to their impression that the Black applicant was unprofessional or underskilled, but they will not have cognitive access to how skin color affected their decision-making process. Abel and Burger's (2023) study found that employers associated names that are racialized as Black with lower levels of education, productivity, and skills. This belief about lack of education, productivity, or skill is what is likely to be cognitively accessible rather than the biased foundation for those beliefs. This is a problem for the internalist perspective. Abel and Burger's study also introduced a sliver of hope for internalists. They found that if employers were given a longer period of time to make decisions, some employers were less likely to use their "racial heuristics." They also found that some employers were able to override their racial heuristics with sufficient time, which may suggest that they were able to cognitively access their bias—or it may reveal that these individuals were wrong even by their own subjective standards or never really attempted to form a justified belief in the first place. However, Abel and Berger make a point to state that inattention is a major determinant of who rethinks their beliefs and racial heuristics. But since there may be no internal cognitively accessible reason to address implicit biases, they remain a problem for internalism. Even the most rigorous investigation of what is cognitively accessible is not going to reveal the bias that went into informing an original snap judgement (that is not to say one can't notice it once they have been informed of its existence, but they will not notice the bias happening, only the results thereof). Therefore, even when individuals make a new decision after having more time, they might still mistakenly think that they were misinformed or merely ignorant earlier rather than biased, which further complicates internalism's ability to serve as a complete theory of knowledge.

Ignorance is, in essence, what shapes what is cognitively accessible to an individual. If a subject is ignorant of the shape of France, then that subject will never be able to compare it to a

hexagon. Similarly, if a subject is ignorant of what many Black people say about their experiences of microaggressions, the comparison to harm will never be cognitively accessible to that subject. An individual who has cognitive access to broader ideas (such as the shape of a hexagon or what it is like to experience harm), but lacks the first-hand experience of a specific instance of this broader idea ought to be able to be held accountable for not making the connection. Even if you have never seen France on a map, if I say it is hexagon shaped, you should be able to understand France's shape to some extent, even without knowledge of the actual shape of France. Now imagine that someone knows what a hexagon is and I begin to say, "France is shaped like a hexagon…" but they immediately stop listening to what I am saying the second I say "France." This individual remains ignorant of the shape of France; they have no cognitively accessible knowledge about the connection between the shape of a hexagon and France, even if they have seen France on a map. This person has deliberately chosen to remain ignorant about France.

It seems intuitive that it is this individual's "fault" for this ignorance, and if they were to be tested on comparing France to a shape and they failed, we would not be sympathetic to their plight. While this silly example is obviously not in and of itself a matter of justice, when the example changes from the shape of France to knowledge of what racial microaggressions are, that is when we turn from conversations solely about knowledge and who knows what and towards epistemic responsibility and epistemic justice, which address ideas like "who is responsible for knowing what, and when?" And "can not knowing something or being wrong be moral failures?"

Matthias Gross and Linsey McGoey (2015) in *The Routledge Handbook of Ignorance Studies* explain that "Ignorance is not a motionless state. It is an active accomplishment requiring ever-vigilant understanding of what not to know." While this understanding explains why I believe that we can sometimes hold people accountable for things they do not know, I want to be clear that I am not arguing that we should hold people accountable for things that they *cannot* know. This forms the crux of my concern about internalism's "cognitive accessibility" clause: some people choose to keep themselves from having access to certain types of information.

Additionally, I also want to make note that not all forms of active ignorance are created equal. The prior example of remaining actively ignorant about microaggressions is doubly a moral failure because it is based not only in ignorance but also bias and/or malice. However, there exists morally relevant types of active ignorance not motivated by bias or malice, such as cases that arise from doxastic anxiety or, more negatively, doxastic cowardice (*PhilosophyTube* 2021). These active ignorances might result in people being unaware of the consequences of their actions and producing circumstances where they lack cognitively accessible evidence of their moral failure. Despite this, I believe the consequences of exonerating everyone in these situations (or allowing them to self-exonerate, as is the danger of internalism), would allow for the proliferation of vice and moral failure. A successful theory of knowledge and epistemic responsibility needs to be able to hold people accountable for the consequences of their actions that result from ignorance.

In addition to these active forms of ignorance, I also have concerns about passive forms of ignorance. Particularly, I worry that implicit bias is by definition not cognitively accessible but does influence our decisions and beliefs about what we think we know (or think we are justified in believing), particularly when it comes to judgement calls like when we are evaluating CVs or journal

submissions (Saul 2013). I also believe that since it seems highly likely that implicit biases impact how we form judgements and what might seem like knowledge (or justified belief) from an internal perspective we also need to adjust our theories of knowledge formulation to deal with this challenge.

In total, internalism certainly fails to adequately address concerns about knowledge formation in cases of ignorance, both active and passive. Particularly, internalism allows for individuals to believe that their biased beliefs (especially those without cognitively accessible counter-evidence) count as justified belief. As such, we have encountered an issue with internalism, it allows people to mistake ignorance for knowledge/justification. While using the rules of internalism from an outside perspective may or may not be successful in determining if a subject has proper justification for a belief, it is certainly flawed when applied by and within one subject. This is surely an issue for a theory which relies on what is cognitively accessible to a subject. While whether externalism falls into this same trap falls outside the scope of this paper, at first glance it appears that we can use externalism to discount these actively ignorant and/or passively biased individuals for not having the right relationship to the truth (due to their bias and ignorance.) As such, I disavow internalism due to concerns that holding ourselves accountable to only what is cognitively accessible at an individual level is irresponsible and allows for forms of discrimination and prejudice to flourish under the guise of knowledge.

References

Abel, Martin, and Rulof Burger. 2023. "Unpacking Name-Based Race Discrimination." *Social Science Research Network*, January. https://doi.org/10.2139/ssrn.4490163.

Gross, Matthias and Linsay McGoey. 2015. "Introduction." In *The Routledge International Handbook of Ignorance Studies*, edited by Gross Matthias and Linsay McGoey. Routledge.

Nagel, Jennifer. 2014. *Knowledge : A Very Short Introduction*. Oxford University Press.

Pappas, George. 2023. "Internalist vs. Externalist Conceptions of Epistemic Justification." In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta and Uri Nodelman. Stanford University. https://plato.stanford.edu/entries/justep-intext/#AcceInte.

PhilosophyTube. 2021. "Ignorance & Censorship | Philosophy Tube." YouTube. 2021. https://www.youtube.com/watch?v=ATITdJg7bWI.

Rudy-Hiller, Fernando. 2018. "The Epistemic Condition for Moral Responsibility." In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. Stanford University. https://plato.stanford.edu/entries/moral-responsibility-epistemic/.

Saul, Jennifer. 2013. "Scepticism and Implicit Bias." *Disputatio* 5 (37): 243–63. https://doi.org/10.2478/disp-2013-0019.

Turri, Mark, John Alfano, and John Greco. 2019. "Virtue Epistemology." In *Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. University. https://plato.stanford.edu/entries/epistemology-virtue/.

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The Spoils of Genocide

Mckenzie Hughes

This essay sets out to investigate the factors that facilitated the Holocaust, arguing that the genocide resulted from the intersection of personal gain—economic, career, and social—and fundamentally restructured cultural norms. Moreover, this essay demonstrates how the Third Reich incentivized complicity through the promise of status, material profit, and career advancement. Drawing on analysis from Christopher Browning, the paper explores how the Nazi regime co-opted the concept of *Volksgemeinschaft* (people's community), redefining it as an exclusive racial category that effectively removed moral obligations toward those outside the group. The essay concludes that this shift in moral language, combined with the allure of self-betterment, fostered an environment where radicalization was rewarded and violence became a normalized expectation.

Keywords: The Holocaust, Third Reich, *Volksgemeinschaft* (people's community), radicalization, conformity, benefits

Dorothy Sölle, in her introduction of Inge Scholl's 1983 publication, *The White Rose*, recalls the question that hung thick in the air after the Holocaust: "How could it have happened?" This essay tackles that very question and investigates the implications of Nazi leadership on German social and political culture. I attribute the destruction of the Holocaust to the intersection of the idea of gain (social, career, economic) and restructured cultural norms. Both of these new notions under the Nazi regime led to increased radicalization and acceptance of violence in the Third Reich.

To begin, many people benefited from the Third Reich—whether it be through direct action or indirect indifference. The benefits extended beyond those intimately involved in the creation and execution of the Holocaust. Following Nazi encounters, it was not uncommon for non-targeted civilians in Germany and other occupied territories to loot from neighbors: "many non-Jewish people profited from the deportation and murder of Jewish populations…. [I]mmediately following mass shootings, locals seized clothing, jewelry, furniture, and entire homes owned by their Jewish neighbors."[1] The photograph by Otto Leyse on the US Holocaust Memorial Museum's website shows droves of ordinary men and women in Dessau, Germany blissfully unaware of the fate of their Jewish neighbors as they take items from their stores.[2] The photograph caption reads: "Local people raid a Jewish-owned store during the anti-Jewish violence of November 1938. Nazi Party members and paramilitaries led most attacks on synagogues and businesses owned by Jews. Encouraged by authorities, many ordinary Germans joined in the destruction."[3] Egged on by Nazi Party members, the German people accepted violence as a means to an end, and therefore such violence became something expected. They turned away so as not to see the persecution of Jews and focused on what they sought to gain; the Nazis effectively outsourced their terror to groups who stood to benefit from genocide and better themselves economically or socially. Though they may

not have fully grasped the death and destruction that lay ahead for many Jewish men, women, and children, they knew well enough that the Jews would not need their goods any longer.

While ordinary German citizens benefited, Nazi party members gained many advantages just by affiliation. Take the Riefenstahl family, for example: Leni Riefenstahl's father, Alfred, was susceptible to Nazi propaganda due to his conservative German nationalism, and "he joined the Nazi Party, and with immediately beneficial effects on his now failing business."[4] Economically, the Riefenstahl family enjoyed profits that they might not have gained without Nazi influence behind them. Leni Riefenstahl, herself not a party member, gained worldwide prominence and social status: "her encounter with Hitler made her one of the very few women to achieve a position of real prominence in the Third Reich."[5] Indeed, the Third Reich fundamentally restructured how women fit into society. For Leni Riefenstahl, her proximity to the *Führer* meant she was able to escape from the virulent idea that women were purely home-and-baby-making machines who would raise the next generation of healthy, obedient Nazis and instead continue movie producing with abundant resources. More than most women, she benefited greatly.

Reinhard Heydrich's wife, Lina, is another prime example of those indirectly involved, for the manor that she lived in after her husband's death "continued to be worked by some thirty Jewish forced labourers, whom Lina ordered to be beaten if they did not work hard enough. They were taken off to the extermination camps in January 1944 and replaced by fifteen women from the concentration camp at Ravensbrück."[6] Lina was from a minor German noble family that saw the Nazis as an opportunity to regain their lost status. Like her relatives, she was a dedicated Nazi Party member and turned Heydrich over to the Party during his times of desperation.

Heydrich himself also stood to gain much in terms of social and career status. After his dishonorable discharge from the Navy, "it was not the lack of income that affected Heydrich most… it was the lack of uniform. Deprived of the prospect of a military career, he turned instead to the Nazi Party."[7] The Nazis offered him a new avenue to success, one which he took in stride. He devoted himself fully to the program, for his drive "throughout his career was a relentless and uncompromised quest for victory, a burning desire to ensure the implementation of Nazi ideology to the fullest possible extent."[8] The cultural norms under the Third Reich allowed people like Heydrich to pour their souls into working towards the *Führer*, increasingly becoming more radical—and more violent—in order to advance in their careers. This destruction was welcomed and even became commonplace. Lina, too, was a part of the atrocities of the Third Reich—actively benefiting from the murder and enslavement of humans to perform menial cleaning work. Both Heydrichs improved their own conditions at the expense of other humans' lives and dignity. Was there no moral obligation toward their fellow brothers and sisters?

Christopher Browning, in his special lecture with the Illinois Holocaust Museum, illustrates how the Nazis fundamentally altered German culture—and the very idea of morality itself. He states that the Nazis took two existing concepts (people's community and comradeship) and co-opted them to aid in pushing conformity, i.e., supporting the group over the individual and not being an outcast. Moreover, he explains, "if you can expel someone from the community of human obligation, they are vulnerable. The Germans, in taking the term 'the people's community' and turning it into the racial community, had basically taken what was a very inclusive term and turned it

into a very exclusive term."[9] Through this change in language, Browning argues, the very notion of morality also became something exclusive—especially with the "racial community" taking precedent. Beyond the German *Volksgemeinschaft*, people owed no one else any moral obligation. If someone were to dissent against the Nazis, then they would be viewed as sinning against the racial community and all of their comrades. This is evident by the swift death sentences and numerous condemnations against members of the White Rose, characterized by newspapers as "irresponsible lone wolves and adventurers, who by their acts had automatically excluded themselves from the community of the *Volk*."[10] There was no place for the individual in Nazi Germany, let alone an individual who acted in defiance against the regime. This point is further demonstrated by events experienced by the Scholl family, in which a seemingly innocent man disappeared simply because "he just wasn't a Nazi, it was impossible for him to belong. *That* was his crime."[11] German culture was organized in such a way that the group—the healthy German body—always took precedence, and this notion, combined with the idea of gain, is what spiraled into the mass violence, death, and destruction of the Holocaust.

In the wake of the restructured German cultural atmosphere and economic, social, and career benefits, radicalization ensued across all sectors of society. The Nazis painted the Jewish "problem" as an existential threat and thus "legal and moral considerations were to be disregarded: defending the interests of the 'Aryan' race brooked no compromise… The Third Reich was on a permanent war footing against its supposed internal enemies, existing in a permanent state of emergency."[12] This emergency opened the door for violence and terror to ensure order, obedience, and conformity. Among Nazi officials like Adolf Eichmann, assimilation paved the path to greatness. To succeed, "he assimilated the ideology and behavior of the evil system within which he sought to achieve distinction… His crimes were the crimes of a system."[13] Even years after the collapse of the Third Reich, Eichmann continued to spout Nazi propaganda to anyone who would listen because he was so firmly entrenched in the cultural sphere. He believed through and through that his actions were justified—indeed warranted—because "he had become obsessed with carrying out the complete extermination of the Jews, which was 'necessary in order to preserve the German people in the future from the destructive intentions of the Jews."[14] Eichmann was a product of the Nazi system—a system in which he gained distinction and immersed himself in the ideology of the party, fully believing that his radical, violent plans were merited and vital to survival. The same could be said for mere Nazi conspirators, as illustrated by Irma Grese, a young woman whose position as a camp guard granted her authority unbound. After her death sentence, "the letter she wrote from her condemned cell to her family [revealed] her to have retained in full the illusions of Nazism…. Her conscience was unsullied, she insisted. She was dying for her beloved Fatherland."[15] So entrenched and embedded was Nazi ideology in German society that it proliferated down the ranks of command—seeping into the very fabric of German culture and effectively reconstructing notions of terror. Violence, in the name of the *Volksgemeinschaft* and the *Vaterland*, was validated and endorsed.

In conclusion, the convergence of new cultural norms and potential for social, economic, and career gain under the Nazi regime spearheaded radicalization across German society. Violence became accepted and expected in order to advance the fervent conviction of the people's

community, the *Volksgemeinschaft*, and inevitably led to the vast destruction and death of the Holocaust.

Notes

[1] Marsha Taplin, n.d. *Her Sister's Needlepoint*, Digital Photograph, *US Holocaust Memorial Museum*, Accessed November 16, 2025. https://exhibitions.ushmm.org/some-were-neighbors/neighbors/sisters-needlepoint.

[2] Otto Leyse, 1938, *Screams and Shattered Glass*, Digital Photograph, *Stadtarchiv Dessau-Roßlau Signatur: FI 86c-0001 from US Holocaust Memorial Museum*. https://exhibitions.ushmm.org/some-were-neighbors/neighbors/shattered-glass.

[3] *Ibid.*

[4] Richard Evans, 2024, "The Star: Leni Riefenstahl," in *Hitler's People: The Faces of the Third Reich*, Penguin Press, 432.

[5] *Ibid.*, 430.

[6] *Ibid.*, "The Hangman: Reinhard Heydrich," 317.

[7] *Ibid.*, 309.

[8] *Ibid.*, 313.

[9] Browning, Christopher, 2021, "Ordinary Men: Reserve Police Battalion 101 and the Final Solution in Poland," Online Lecture, *Illinois Holocaust Museum & Education Center*, 53:24-53:44. https://www.youtube.com/watch?v=Tnt7J9Zet4o&t=460s.

[10] Inge Scholl, 1983, *The White Rose: Munich, 1942–1943*, Wesleyan University Press, 3-4.

[11] *Ibid.*, 11.

[12] Evans, op. cit., 311.

[13] *Ibid.*, "The Bureaucrat: Adolf Eichmann," 322.

[14] *Ibid.*, 330.

[15] *Ibid.*, "The 'Witch' and the 'Beast': Ilse Koch and Irma Grese," 411.

References

Browning, Christopher. 2021. "Ordinary Men: Reserve Police Battalion 101 and the Final Solution in Poland." Online Lecture. *Illinois Holocaust Museum & Education Center*. 1:05:35. https://www.youtube.com/watch?v=Tnt7J9Zet4o&t=460s.

Evans, Richard. 2024. *Hitler's People: The Faces of the Third Reich*. Penguin Press.

Leyse, Otto. 1938. *Screams and Shattered Glass*. Digital Photograph. *Stadtarchiv Dessau-Roßlau Signatur: FI 86c-0001 from US Holocaust Memorial Museum*. https://exhibitions.ushmm.org/some-were-neighbors/neighbors/shattered-glass.

Scholl, Inge. 1983. *The White Rose: Munich, 1942–1943*. Wesleyan University Press.

Taplin, Marsha. n.d. *Her Sister's Needlepoint*. Digital Photograph. *US Holocaust Memorial Museum*. Accessed November 16, 2025. https://exhibitions.ushmm.org/some-were-neighbors/neighbors/sisters-needlepoint.

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The Positives of a Political Friendship

Reagan Grace Wheat

This paper examines the concept of political friendship as a framework for bridging partisan divides and strengthening democratic engagement in the United States. It argues that political friendship relies on active citizen communication, mutual trust, and the development of civil competence. Drawing on interdisciplinary scholarship, the paper explores how trust in both fellow citizens and governmental institutions has declined, and how practices such as empathetic listening, rhetorical awareness, and recognition of shared experiences can help rebuild that trust. However, the paper also acknowledges challenges such as biased information transmission, moral polarization, and biases that complicate political dialogue and highlights how deliberate engagement and reflective thinking can foster more productive conversations across ideological lines. Additionally, it introduces an applied component: a card game designed to facilitate structured, inclusive political discussions as a practical tool for cultivating political friendship. Ultimately, the paper argues that despite deep partisan divisions, political friendship is both achievable and essential for promoting a more inclusive, informed, and trustworthy democratic society.

Keywords: political friendship, institutions, trust, dialogue, partisan, democratic, bias

The concept of political friendship assesses the ways in which citizens can bridge partisan gaps and come together to communicate about government and institutions of authority. By studying political friendship, scholars are able to evaluate the way in which citizens not only trust one another but also trust the structures that govern them. However, the barriers to political friendship lie in its execution. Political information exchanged in conversations can be biased, and attitudes toward the ideas being expressed can halt the progression of understanding between people. However, at its core, political friendship fosters an inclusive environment that aims to bridge the partisan gap that often arises in American politics. Political friendship is possible through the active engagement of citizens' communication with one another and the use of civil competence and communicative factors to spread accurate political information to other citizens. By actively engaging in this process, all citizens, regardless of their partisan affiliation, will benefit from the achievements of these collaborative efforts.

The role of civil competence within the realm of creating political friendship is pertinent to understanding how interactions between citizens can improve governmental institutional practices. Civil competence is a combination of knowledge, skills, attitudes, and values that enable a person to perform tasks (Cramer et al. 2017). While it is important to get the right information across when interacting with a political friend, it is even more important to govern with compassion, justice, and equity to understand where the other side is coming from. Personal experience is a major factor in the act of making sense of politics and therefore should be studied hand in hand with civic competence. Through the act of consciously participating in civic competence, the public can

simultaneously engage in the system of political friendship. Therefore, political friendship is not only possible, but society is well-suited to accomplish it.

Being conscious about your interactions with fellow citizens and understanding others' lived experiences can bridge the gap between parties. In the article "Turning Strangers into Political Friends," Danielle Allen (2004) evaluates the way in which American citizens' trust in the government and other institutions has largely declined over time. This contributes to the idea that trust is registered cognitively and that the distrust of fellow citizens directly leads to the wariness of governmental ability. However, distrust can be overcome when citizens follow methods that generate mutual benefits and navigate differences of position, experience, and perspective. Democratic disintegration can be combated with these principles that guide not only political friendship but relationships in general. Allen explains that friendship begins as the "recognition that friends have a shared life—not a 'common' nor an identical life—only one with common events, climates, built environments, fixations of the imagination, and social structures." This idea of friendship is similar to the ethos of democracy, as it requires understanding a practice of "hard-won, complicated habits used to bridge differences of personality, experience, and aspiration" (Allen 2004). Friendship is not easy, nor is democracy. Through the constant practice of listening to others and engaging in difficult conversations, the effort to participate in political friendship will strengthen the stability of not only the friendships around you, but also democracy.

Political friendship often relies on communication and the exchange of information between citizens in order to succeed. Often used in this communication is the application of rhetoric, which refers to the various ways something can be said and the effect it has on the audience (Young 2000). This is important because rhetoric often changes the way people think about and interpret a conversation. In order to cultivate political friendship, the political functions of communication are important to note, such as greeting, rhetoric, and narrative (Young 2000). These all enable understanding and interaction in ways that argument alone cannot and foster an inclusive environment for political friends to thrive. Furthermore, Young states that these three practices are easy to accomplish. Actions as simple as a greeting allow for the relations of discursive equality and mutual respect among parties. Recognition is a primary starting point for political interaction and contest and is a great first step to fostering a political friendship.

According to the article "Modeling Political Information Transmission as a Game of Telephone," individuals often express biased information that goes on to affect learning and vote choice. These findings pose a challenge to democratic governance by setting limits on political judgement and a lack of investigation into the information being presented (Carlson 2017). This contributes to negative perceptions of political friendship due to inaccurate information being exchanged among citizens, which creates more opportunities for misunderstandings across party lines and subsequently contributes to more polarized voting patterns. Carlson states that these polarizations lead to political information being transmitted inaccurately because individuals tend to self-select information to share. However, the article states that a limit to this research can be seen in the level of biased information one has on political decision-making. For example, voting patterns are not proven to be affected by the hypothesis of biased decisions that the study is evaluating. This means that the misunderstandings and biased information that can be taken from

conversations of political friendship are not proven to affect voting outcomes or trust in governmental structures.

The American two-party system is drastically divided into the Republican and Democratic parties, which have different ideological and moral foundations. These often stark differences have been linked with influencing issue preferences such as candidate trait evaluations and vote choice (Kraft 2018). While liberals prioritize qualities such as care and fairness, conservatives are more likely to support traits such as loyalty in a candidate. This moral divide alone can influence election cycles as well as the interactions citizens have with one another. The concept of relative advantage helps frame this issue. Relative advantage is the idea that citizens prefer one idea over another and estimate the values of each according to their liking (Ariely 2009). This does not create an environment for political friendship to thrive because moral considerations in attitude expression are amplified by the moral content of an individual's opinion. While this is discouraging, political friendship is not just the recognition of a shared horizon of experience and neither is it a blind trust in one's fellow citizens, but rather a core citizen responsibility to prove oneself trustworthy to fellow citizens (Allen 2004).

In order to break this divide of moral considerations, citizens must be willing to engage in conversation with one another about why these barriers exist between them. It is important to consider the way the brain has impulses to the information being presented. Dan Ariey's (2009) chapter "The Characters of The Story" explores the two systems our brain goes through while processing information. System one is the automatic functions of attention and memory, while system two is attention to effortful, more mental activities that take place while breaking down an issue (Ariely 2009). These systems allow for the opportunity for common ground by promoting open-mindedness in system two, instead of automatically biased thinking in system one. To accurately cultivate political friendship, the conscious task of using these systems to improve communication is imperative to the success of decreasing political polarization and trust in government institutions.

The idea of political friendship is to bridge the gap between party divides and connect with fellow citizens to create a more trustworthy government. Barriers such as different moral foundations and ideologies can deter citizens from these conversations. However, at a basic level, the idea of friendship is the same as democracy. The constant practice of listening to others and engaging in difficult conversations will create a more open-minded political system and encourage representatives and government institutions as a whole to practice these processes, too. In the end, when citizens actively engage in the process of political friendship, people on both sides of the political ideology will be able to benefit from its achievements by fostering an environment for a more inclusive and trustworthy government.

Application: Political Friendship the Card Game

Political Friendship is a card game aimed at bridging the gap between individuals and their political opinions. The game contains three different levels, including different topics with a wide range of politics to help engage the players in thinking about current issues, developing vocabulary, and improving their communicative abilities about difficult topics. Within the major polarization

facing the nation today, as a society, we have largely been taught not to talk about politics. Without talking about political topics, individuals within our society are being further pushed away from one another, and polarization is being further encouraged. Professor Williams's Political Science 340 class taught me that with deliberate thought and compassion toward one another, politics does not have to be excluded from our discussions. We can make a real difference in others' understanding of the world if we work together to bridge the gap.

I chose the format of a card game because it encourages many different factors necessary for understanding political thought. The card game consists of three levels that have twenty cards in each deck. This design provided a good amount of discussion possibilities within each level and was important because it allowed participants to discuss a wide range of topics. Level one included topics such as asking if participants are registered to vote and what party their representatives belong to. In this level, I was encouraged by "How Politics Breaks Our Brains and Puts Them Back Together" by Brian Resnick. Resnick (2014) states that America's partisan divide is as old as America's democracy. However, he also states we can move past this if we all work from the same set of facts. Differences in opinion would and should remain the same in these situations; however, facts help Americans who are not as involved in politics gain knowledge. I implemented fact-checking in the game by encouraging players to use their phones to look up events or vocabulary they hadn't encountered before.

Level two elevated participants by asking questions about people's direct political participation. For example, a card asks players if they always vote for the same party. The most serious political topics discussed can be found in level three. This deck asks more specific questions about events and policies that have recently been introduced in America. A question that could be found in that pack is asking players' opinions about campaign finance laws.

Points I focused on were the time of gameplay, number of people playing the game, and the rule that players are not allowed to skip cards. With these parameters introduced correctly, I believe that participants would be willing and encouraged to play and to share their responses openly. An issue I ran into was players not discussing cards or not discussing cards for a long amount of time. After playing with friends, I realized certain card topics sparked much more participation, which surprised me because I thought participation between individuals would be low. This sparked my motivation to make the cards have a strict three-to-five-minute discussion limit per individual and to buy a timer for participants to know when their time is up. Furthermore, with cards that incite more serious political topics, the time limit allows uncomfortable players/citizens to know when the topic might change into something they're more comfortable with.

Danielle Allen (2004) states that distrust can be overcome only when citizens manage to find methods of generating mutual benefit despite differences in position, experience, and perspective. She also says that the discovery of such methods is the central project of democracy. This was a major factor in my project by helping guide how these cards will directly create a space to overcome this distrust.

Finally, the idea of communication and trust between the group playing the game is important. In "Inclusion and Democracy," Iris Marion Young (2002) discusses tone and greetings. Young states that in regular day-to-day communication and conversing, there are no formalities

hindering citizens from engaging in hurtful language, which therefore can hinder participation. When we discussed this in class, I thought it wasn't as important as other factors. However, while building the game, I realized that participation will not be high unless the environment is inclusive of all ideals. When participants explicitly acknowledge others and agree to respect one another, I believe we can foster a better understanding of political knowledge.

References

Allen, Danielle. 2004. "Turning Strangers into Political Friends." *In These Times*, December 22, 2004. Accessed October 3, 2023. https://inthesetimes.com/article/turning-strangers-into-political-friends#content

Ariely, Dan. 2009. *Predictably Irrational*. HarperCollins.

Carlson, Taylor N. 2018. "Modeling Political Information Transmission as a Game of Telephone." *The Journal of Politics*. https://doi.org/10.1086/694767

Cramer, Katherine J., and Benjamin Toff. 2017. "The Fact of Experience: Rethinking Political Knowledge and Civic Competence." *Perspectives on Politics* 15 (3): 754–770. https://www.jstor.org/stable/26615144

Kahneman, Daniel. 2012. *Thinking, Fast and Slow*. Farrar, Straus and Giroux.

Kraft, Patrick W. 2018. "Measuring Morality in Political Attitude Expression." *The Journal of Politics*. https://doi.org/10.1086/696862

Resnick, Brian. 2014. "How Politics Breaks Our Brains, and How We Can Put Them Back Together." *The Atlantic*, September 19, 2014. Accessed December 19, 2023. https://www.theatlantic.com/politics/archive/2014/09/how-politics-breaks-our-brains-and-how-we-can-put-them-back-together/453315/

Young, Iris Marion 2003. *Inclusion and Democracy*. Oxford University Press, USA. https://academic.oup.com/book/3941

Young, Iris Marion. 2003. "Introduction," *Inclusion and Democracy*. Oxford Academic online ed., November 1, 2003. https://doi.org/10.1093/0198297556.003.0001, accessed 3 Oct. 2023.

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MAT as a Vehicle to Sobriety

Alyssa Gent

This essay recounts the history of Medication-Assisted Treatment (MAT) and compares this treatment method to other treatments such as Narcotics Anonymous (NA), Alcoholics Anonymous (AA), and clinical treatments. The essay considers the advantages and shortcomings of MAT as a vehicle to sobriety.

Keywords: Medication-Assisted Treatment (MAT), addiction, opioids, narcotics

In the early 20th century, America was beginning to take notice of an issue plaguing the public. The problem had always been in the background, but as the country became more conscious of a singular culture, the issue of drug and alcohol addiction gained public concern. Much of the attention garnered by the subject was driven by fear or disdain. It wasn't until the 1990s that the overall narrative on drug addiction was beginning to point towards that of healing. Since this change of opinion, different treatment options have been popularized as treatments for addiction. One of these treatments, that are now normalized in the 21st century, is MAT.

MAT, for those unfamiliar, stands for Medication-Assisted Treatment. It is the practice of treating OUD (Opioid Use Disorder) by medicating the addict suffering from it. MAT uses specially designed opioids to treat the disorder by targeting the same part of the brain that recreational drugs do. When the MAT drug is used, it occupies the addict's brain receptors so that recreational use of opioids doesn't affect them. In theory, this keeps addicts safer while still fighting addiction, highly reduces the patient's cravings for opioids, and makes it easier for the patient to stop using the opioids and stay sober after the process of treatment.

History of MAT

As mentioned above, the general public wasn't always as aware of the issue of addiction as is standard today. The 1960s were a sort of dawn of information in America about the treatment of narcotics addictions. For reference, at this time, an alcoholic was seen as much worse than an opioid addict. This stereotype (although requiring a much more nuanced conversation to accurately quantify addiction) is almost the opposite of what it is today. Alcoholics were seen as sloppy and belligerent, whereas opioid addicts were seen as quiet and reserved. Despite these misconceptions, all kinds of addicts were routinely thrown into both prisons and insane asylums. This is likely because at this time, addictions were seen not as the disease that they are, but moral failures and personality flaws of the people suffering from them (Payte 1991).

It was even illegal to prescribe addicts medication for the most part. One case documents an experimental doctor who wanted to try out an early form of Medication-Assisted Treatment in the 1930s. He prescribed opioids to a patient to help with his OUD, but when people caught wind of the experiment, the doctor was arrested, lost his license to practice medicine, and was fined about $30,000 in modern American dollars. People were not yet willing to hear about the possibility of medication as a treatment for addiction (Payte 1991).

Starting in the 1960s and into the 1970s, a minor shift in opinion occurred. Whereas before addicts were usually locked up or left to their own self-destruction, a new narrative of healing began

to enter the scene. Starting with the Kennedy administration in 1961, there was a focus shifted towards the betterment of American citizens. Domestic policies implemented at the time—like raising minimum wage and lowering taxes—indicated a renewed interest for politicians to invigorate the (white, cis-hetero, American-born, male) working class citizens (Selverstone 2023).

Not incidentally, the Vietnam War was happening at the time, which caused drug use in our overseas military soared. Research shows that 51% of soldiers reportedly smoked marijuana, and as many as 28% used *hard drugs* like cocaine or heroin; as a result, many came home addicted. While historically soldiers returning from war would be revered, many of the soldiers returning from Vietnam carried the unfortunate burden of addiction (History.com 2024). Seeing these young servicemembers come back from the frontline with a disease rather than medals was certainly a catalyst in shifting public opinion to seek out the best treatment for people addicted to drugs.

At around the same time, Alcoholics Anonymous (AA) was gaining traction and support in the mainstream (Miller 2024). AA—and eventually Narcotics Anonymous (NA)—emphasize healing mentally and spiritually as a path to getting and staying sober (GateHouse 2024). This earnest approach, along with the desire to heal addicts—particularly those returning from the Vietnam War—made treatment for addiction more easily digestible to the general public. Riding off this wave was the New York Academy of Medicine, which in the 1970s began testing early iterations of methadone treatment. Their work led to the approval for methadone to be used to treat OUD in 1974. This is when the first MAT clinics started to open (Wakeman et al. 2020).

The 1980s–1990s were some of the worst years of the heroin epidemic in the United States: not as defined exclusively by the sheer number of addicts, but certainly indicated by the fear gripping the public, which was racialized and affirmed by classism. This increased attention, along with the context of the fearmongering accomplished in the 1970s' War on Drugs, made white upper-class Americans take a stance that something had to be done to address the problem. It was during this era that MAT treatment became a viable option as it faced much less stigma to discuss and popularize (Wakeman et al. 2020).

All of these steps led us to the present day. Medication-Assisted Treatment is now fairly common in America (National Institutes of Health 2021). Without the normalization of treatment and the hard work spent educating the public over the course of decades, we would not have made it to where we are now. MAT has reduced the number of opioid tests coming back positive by anywhere from 14%-33% (Wakeman et al. 2020). That statistic may not seem special outside of context, but it is important to remember that within those percentages are real people whose lives were shaken by their own addictions, who are now getting help on the path to healing. Overall, MAT clinics serve over 400,000 people across the United States, demonstrating along with the statistics of positive test reductions, that there's no denying the influence they've gained in the past century (Release 2015).

Medications of MAT

Because of staunch restrictions around MAT and health standards, only three drugs have been approved by the FDA to treat opioid use disorder. The first of the three is methadone: the oldest and still most used. It was invented in 1937 by Nazi soldiers as an alternative to morphine. It was abandoned due to unwanted side effects until the 60s when it was picked up again for its potential to treat addiction (Release 2015). It works by affecting the brain in the same way as other opioids: by blocking the patient's pain receptors. It is effective because when the patient's receptors are occupied with methadone, taking opioids recreationally will have little effect. Methadone treatment requires daily in-person visits to a clinic. However, sometimes, if a patient has proven themself trustworthy, they may be allowed to take doses home so they can visit the clinic less frequently (WOOD TV8 2018). The other two drugs used in MAT are very similar.

Buprenorphine was discovered in 1966 while MAT clinics were forming, but it wasn't approved to treat patients alongside methadone until 2002. Overall, it operates much the same as its partner drug. It needs to be taken daily and is provided by a clinic through oral doses in which a pill dissolves under the patient's tongue (Miller 2024). However, unlike methadone, the way it occupies a patient's pain receptors doesn't allow for as intensive of a high as methadone does. This fact makes suboxone harder to get addicted to while maintaining the quality of reducing the effects of recreational opioids (Hazelden Betty Ford Foundation 2019).

Naltrexone is an improvement on buprenorphine. It was introduced before suboxone, but some of its most important uses have only just been discovered. In addition to use in MAT, naltrexone was approved recently for an alternative use in the form of the nasal spray Narcan. Narcan is a lifesaving medication used on people overdosing on opioids that helps to stabilize the person until they get access to medical attention. Through its Narcan form, naltrexone has helped save the lives of 27,000 people from overdoses (CADCA 2024). Aside from this added advantage, it has the same function and utility as the previously mentioned treatment options, but instead of being administered in daily oral doses, it is commonly administered through weekly intravenous doses. In addition, it more reliably avoids giving the user a high while also reducing cravings for opioids and alcohol (Miller 2024).

MAT vs. Alternative Treatments

Despite having the same goal, the difference in the experiences of a patient going through clinical MAT and someone seeking out alternative treatments like NA or AA can vary wildly. Firstly, alternative treatments like the two mentioned here focus on the betterment of the individual person through reflection. These programs rely on staunch sobriety and often start with a stay in a drug-free inpatient rehab that lasts between three months and eighteen months (Miller 2024). Participants form supportive and familial bonds within the programs as a part of the process to help each other stay clean. These programs expect participants to find the root of the issue of their addictions, and because of that, people who find success in them are typically able to live sober lives more often than those who only receive MAT. Unfortunately, because so many people struggle to go "cold turkey" in the way that these programs are based around, the success rate of MAT treatment is slightly higher (GateHouse 2024). Positive opioid tests appear 14–33% less frequently among MAT patients than addicts on other treatment options.

MAT relies on chemical inhibitors to reduce the amount of resolve needed to stay off drugs. It focuses on and is able to assist patients with opioid, heroin, and alcohol addictions by targeting and occupying the same center of the brain. It is a safe way to wean off of these vices in a way that acknowledges the difficulty in the process. Unless being provided in a prison, typically all MAT is outpatient (WOOD TV8 2018). It is a solitary effort that focuses on the individual patient's own reaction to how the medications affect them. As mentioned before, this treatment works to successfully lower the number of positive drug tests the patient provides. The "end goal" of using MAT to get off of opioids is often followed up with reducing the patient's dependency on the methadone/suboxone treatment drug itself (National Library of Medicine 1970). Due to this need for follow through, the best results from MAT usually come from those who are participating in NA/AA alongside it because they have been building the skills needed to not be emotionally dependent on narcotics.

Pros and Cons of MAT

With a topic as nuanced as addiction treatment, the solutions—however successful—are bound to be more complex than simply black and white. For instance, Medication-Assisted Treatment is leagues safer than drug addiction. Because the patient is receiving the treatment (and

the treatment drug) legally, they don't have to deal with the risks associated with drug crime. In the same vein, the clinical aspect eliminates the risk of contracting blood-borne illnesses through used heroin needles. Similarly, there's no risk that the drug the patient is taking in MAT is laced with anything harmful like fentanyl. This treatment can also end up being cheaper than what someone would pay on the street to support their addiction. Additionally, MAT is hypothesized to be a widely applicable solution. Experts claim that with very few outliers, MAT can positively affect most people who take it. Lastly, it does what it sets out to do. The treatment was designed to reduce a patient's cravings for opioids and alcohol, and the statistics support that there are fewer positive opioid tests from patients (Release 2015).

Adversely, there are many aspects of Medication-Assisted Treatment that keep it from being the "miracle solution" many clinics paint it as. Starting off, the path towards sobriety through MAT is extremely long. Patients are typically expected to maintain their treatment consistently for a minimum of two years if it's expected to work. This is made even more difficult when you take into account the fact that many medications require daily visits to the clinic, which can take hours of waiting in lines. Despite the fact that MAT can be more cost-effective than addiction, it is still more expensive than NA/AA. Those programs are free, whereas an individual can end up spending $130 on methadone doses every day for 2+ years during MAT. That's almost $100,000 in the same amount of time they would spend $0 on NA/AA.

Additionally, one drawback is how easily revoked treatment is. Most clinics have the rule that treatment will be terminated after two drug tests that come back positive for opioids. Being dropped from one treatment center can be a heavy verdict, as many people only have one clinic in their area and will have a harder time getting treatment with a termination on their record. In NA/AA, the recovery is always open—a luxury not provided by MAT (Weiss 2023).

Moreover, while making opioids ineffective, MAT does nothing to curb a patient's use of or addiction to any other substances. Many clinics don't care if a patient tests positive for drugs other than opioids, so general drug use is barely prohibited. Many who take advantage of that find that their MAT only intensifies and betters the high of non-opioid drugs. One addict, for example, says that taking Xanax while on methadone creates the same high as opioids (B. 2019) Finally, MAT is not the end of addiction. In many cases, when people finish MAT, they're still addicted to other substances or even the drug used in the treatment itself. One of the most common cases for people who successfully make it through the two years on MAT is to find themselves continuing to receive it for longer than that, with some of the worst cases being people who have spent a decade in these clinics.

To conclude, Medicine-Assisted Treatment was developed over a series of years to get to where it is now in terms of effectiveness and positive societal perception. It is effective in treating addiction on its own, but in consideration of its detractions, it is best paired with other treatment options.

References

B. 2019. "Methadone vs Suboxone: What's Better for Heroin Treatment? | Dr. B." *YouTube*, www.youtube.com/watch?v=ywI3HMMEhvo.

CADCA. "CDC Report: Narcan Kits Save Nearly 27,000 Lives." www.cadca.org/resource/cdc-report-narcan-kits-save-nearly-27000-lives/#:~:text=Nearly%2027%2C000%20lives%20have%20been,Morbidity%20and%20Mortality%20Weekly%20Report. Accessed 3 May 2024.

Diamond Recovery. 2023. "The History of Medication Assisted Treatment (MAT) in America." *Diamond Recovery*, diamondrecovery.com/medication-assisted-treatment-history/#:~:text=It's%20fair%20to%20say%20the,workers%20were%20looking%20for%20solutions.

GateHouse Treatment. "A History of Abstinence Based and Medication Assisted Treatment (MAT)." www.gatehousetreatment.com/blog/history-abstinence-based-medication-assisted-treatment-mat/. Accessed 12 Mar. 2024.

Hazelden Betty Ford Foundation. 2019. "Suboxone, Methadone, Naltrexone: What's the Difference?" www.hazeldenbettyford.org/articles/methadone-vs-suboxone-opioid-treatment. Accessed 3 May 2024.

History.com. "G.I.s' Drug Use in Vietnam Soared—With Their Commanders' Help." www.history.com/news/drug-use-in-vietnam. Accessed 3 May 2024.

Miller, Jessica. "Addiction Recovery Statistics—Treatment Success & Failure Rates." AddictionHelp.Com. www.addictionhelp.com/recovery/statistics/. Accessed 7 Apr. 2024.

National Institutes of Health. 2021. "How Much Does Opioid Treatment Cost?" National Institute on Drug Abuse. nida.nih.gov/publications/research-reports/medications-to-treat-opioid-addiction/how-much-does-opioid-treatment-cost.

National Library of Medicine 1970. "Methadone Maintenance Treatment." Clinical Guidelines for Withdrawal Management and Treatment of Drug Dependence in Closed Settings. www.ncbi.nlm.nih.gov/books/NBK310658/#:~:text=Methadone%20is%20addictive%C%20like%20other,take%20heroin%20of%20unknown%20purity.

Payte, J. Thomas. 1991. "A brief history of methadone in the treatment of opioid dependence: A personal perspective." *Journal of Psychoactive Drugs* 23(2): 103–107. https://doi.org/10.1080/02791072.1991.10472226.

OATC. "Ontario Addiction Treatment Centres." www.oatc.ca/news-articles-information/opiod-agonist-program-suboxone. Accessed 3 May 2024.

Release. 2015. "Methadone." www.release.org.uk/drugs/methadone/history.

Selverstone, Marc J. 2023. "John F. Kennedy: Domestic Affairs." *Miller Center*. millercenter.org/president/kennedy/domestic-affairs.

Srivastava, A Benjamin, and Mark S Gold. 2018. "Naltrexone: A History and Future Directions." Cerebrum: The Dana Forum on Brain Science, U.S. National Library of Medicine. www.ncbi.nlm.nih.gov/pmc/articles/PMC6353110/.

Wakeman Sarah E., Marc R. Larochelle, Omid Ameli, et al. 2020. "Comparative Effectiveness of Different Treatment Pathways for Opioid Use Disorder." *JAMA Netw* Open 3 (2) doi:10.1001/jamanetworkopen.2019.20622.

Weiss, Dominic. 2023. "The Factors That Make Patients Quit Methadone." *Penn LDI*, ldi.upenn.edu/our-work/research-updates/patients-with-opioid-addiction-describe-the-factors-that-make-them-quit-methadone/.

WOOD TV8. 2018. "Outside GR Methadone Clinic: Opioid War's Front Lines." YouTube. www.youtube.com/watch?v=fZ7GMj2TFCk.

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Sickle Cell Disease: New Gene Therapy Treatments

Samuel Roque

This piece discusses how gene therapy is becoming a leading solution for those suffering from sickle cell disease (SCD). However, access to the new treatment is limited by its steep price tag, thus denying its life-saving potential to many. The article draws on several primary sources such as recent studies, cost analyses, and legislative changes to discuss two recently approved genetic therapies: Casgevy and Lyfgenia, both of which involve genetic modification to decrease or prevent vaso-occlusive crises. In order to determine the financial sustainability of increasing access to these therapies, the article compares the cost of SCD care to the lifetime cost of these treatments while arguing that there must be a concerted effort from lawmakers, healthcare professionals, and biotech companies to make the treatment accessible to the public.

Note: This piece was originally written in the form of a speech for a first-year seminar class focused on gene editing to target genetic disorders.

Keywords: Sickle Cell Disease (SCD); gene therapy; CRISPR-Cas9; Casgevy; Lyfgenia; health equity; healthcare access; health policy

Good morning. My name is Samuel Roque, and I am an ally to the sickle cell disease (SCD) community. I am here today to represent those who have no voice in determining who benefits from groundbreaking treatments for this condition and who has little to no power in affecting who has access to them. My perspective is that of an individual who has had to witness the suffering of friends who are afflicted, as well as experience the heartbreak when current treatments do nothing more than put a Band-Aid on a wound that requires stitches. At this 20th Global Summit on Hematology and Infectious Diseases, I will be discussing with you the new gene therapy treatments that are available to treat SCD, as well as the concerns associated with the cost of and access to these treatments by those who need it the most. Millions of people worldwide suffer from SCD and they deserve to receive the best treatments available, regardless of the cost or their demographics.

When we consider the myriad of disorders that negatively affect people today, hematological conditions are of great concern, especially those that are inherited. Equitable access to treatments, whether for sickle cell disease or beta thalassemia (β-thalassemia), has long been difficult to acquire. The associated costs for lifetime treatments create challenges for many, especially those who have historically been marginalized in society. However, recent advances in technology have opened a new pathway for these individuals to obtain treatment that could potentially reduce, if not eliminate, frequent medical interventions.

Let us begin with some cold hard facts. Over four hundred studies have been conducted to examine the annual medical and non-medical costs associated with sickle cell disease. When compared to the annual costs of non-SCD individuals, it was found that the costs for SCD individuals "were higher for SCD patients when compared with non-SCD individuals (cost difference range: $6636–$63,436 annually)" (Baldwin et al 2022). The highest part of the cost is for inpatient care, at an average of "$11,978-$59,851 annually" (Baldwin et al 2022). Conservatively speaking, simple calculation shows that the total potential cost would be $3,108,364 for the lifetime care of just one SCD individual. The condition affects more than 100,000 people in the United States and over 20 million people worldwide. Considering just the demographics of SCD individuals

in the United States, the SCD treatment cost to public healthcare is astronomical. In addition, historically there have been "racialized health inequities" which have created unnecessary hardships for SCD individuals to receive the best treatment (Advancing Health Equity 2024). Nevertheless, to fully understand the implications of these figures, we need to look at and understand this medical condition and how it has been addressed by those with the power to make lives better for SCD individuals.

The majority of those present today are familiar with SCD, but for those who are not, let me provide you with some important information. Sickle cell disease (SCD) is a blood disorder that causes the red blood cells (RBCs) of an affected person to be sickle shaped instead of round. These blood cells then easily stick together and cause blockages in blood flow and oxygen from reaching parts of the body. This leads to serious health problems, including but not limited to: pain, infection, anemia, other complications, and shortened life expectancy. To be specific, "Researchers found that the average life expectancy for publicly insured individuals with SCD was 52.6 years, with male life expectancy at birth (49.3 years) being significantly lower than that of females at birth (55 years)" (Blood Disorder Conference 2024). Men are twice as likely to develop SCD complications than women, and it is more common among minority ethnic groups, such as Hispanic Americans from Central and South America, people of Middle Eastern, Asian, Indian, and Mediterranean descent, as well as African descent, including African Americans (where 1 out of every 12 carries a sickle cell gene).

Previous SCD treatments have mainly been administered to treat the symptoms of SCD and do not offer long term relief. Blood transfusions were among the treatments available, but they require frequent hospitalizations and matching donors to be found. Another option has been hydroxyurea, which is a medication that helps reduce pain crises (vaso-occlusive crises, or VOC) and the need for blood transfusions, but even this has side effects that range from fatigue to bleeding, skin ulcers, mouth sores, etc. (Columbia University 2023). These treatments do not relieve the necessity for chronic care and only focus on reducing organ damage, relieving pain, and maintaining hydration, all of which require further medication. There has been one treatment, however, that has offered long term effects and relief. Until recently, the only cure for SCD has been "a stem cell transplant from a matched donor" (Rare Daily 2023), but these transplants are not done often due to associated risks and challenges. Among the complications is that this option has been available to only a few patients, requires lifelong medical care, and uses extensive medical resources. Additionally, this treatment is only feasible after a suitable matching donor is found, which has always been the biggest challenge faced.

You may ask, then what alternative is there for sufferers of SCD? As of December 8 2023, the FDA officially approved two non-germline (gene-based) therapies for those who suffer from SCD. Casgevy from Vertex Pharmaceuticals and CRISPR Therapeutics, and Lyfgenia from Bluebird Bio Inc. are two therapeutic treatments that have been developed using CRISPR/Cas9 technology. Both have been approved for use in qualifying individuals aged 12 and older, providing they fit the criteria. The criterion for treatment includes having had at least two VOCs per year for two years prior to treatment, having no risk for stroke, and no viable matching bone marrow donors. Casgevy and Lyfgenia are both made from "the patients' own blood stem cells, which are modified, and are given back as a one-time, single-dose infusion as part of a hematopoietic (blood) stem cell transplant" (US Food and Drug 2023). However, prior to being treated, a patient's stem cells are collected from their bone marrow, and they must undergo high-dose chemotherapy to remove all remaining cells from the bone marrow. The marrow is then replaced by the modified cells and the patient is followed by professionals to monitor progress and effectiveness.

So, what is the difference between the two therapies? This question is subjective, as each SCD case is like a snowflake: each individual case is different with varying issues to consider.

Scientifically speaking, Casgevy utilizes "CRISPR/Cas9, a type of genome editing technology" (US Food and Drug 2023). In essence, CRISPR/Cas9 is used to cut DNA in specific targeted areas, which allows for accurate edits (replace, add, or remove) of DNA at the cut points. Once these edited cells are transplanted back into the patient, the cells attach and multiply in the bone marrow and increase the production of fetal hemoglobin (HbF). This fetal hemoglobin helps oxygen delivery, which helps prevent the sickling of red blood cells in SCD patients. On the other hand, Lyfgenia as a cell-based gene therapy utilizes "a lentiviral vector (gene delivery vehicle) for genetic modification" (US Food and Drug 2023). To be specific, the blood stem cells of the patient are modified genetically to make HbAT87Q. This hemoglobin (created through gene therapy) works like hemoglobin A, which is the hemoglobin that non-SCD adults produce. The presence of HbAT87Q in red blood cells lowers the chances of sickling and blocking blood flow. As with Casgevy, the edited stem cells are transplanted back into the patient and the results are monitored.

As far as which is the better option, again, the choice depends on the individual, and decisions are made on a case-by-case basis. What should be noted first is the current success rate of each therapy to determine which of the two may be a better choice. In two separate studies, the patients who received the different treatments were followed for a period of two years (24 months). For Casgevy, all the treated patients had freedom from a major crisis event (VOC) for the first twelve months of the study. More specifically, "Of the 31 patients with sufficient follow-up time to be evaluable, 29 (93.5%) achieved this outcome" (US Food and Drug 2023). In addition, all the treated patients (44 in total) successfully achieved engraftment (no graft failures or rejection). For Lyfgenia, the success was based on patients having no major crisis events six to eighteen months after infusion. Data showed that "Twenty-eight (88%) of 32 patients achieved VOE-CR during this time period" (US Food and Drug 2023). These results suggest Lyfgenia can successfully treat SCD and is also an option to consider.

The next question that needs to be considered relates to the side effects that are possible from the two treatments. This is where we can truly see which of the therapies may be the better option. As for Casgevy, the most common side effects were various types of physical pain: headache, nausea, vomiting, mouth sores and low blood cell counts. Lyfgenia users reported similar side effects, with one troubling addition to the list. Some patients treated with Lyfgenia have experienced "Hematologic malignancy (blood cancer)" (US Food and Drug 2023). This is cause for concern, as a new health crisis is a possible result of treating the original health concern. Patients who choose Lyfgenia need medical follow-up for the rest of their lives to monitor for these malignancies. In either case, many questions need to be considered, and everyone must weigh the benefits–risk ratio when deciding which treatment would be best to pursue.

Now, and perhaps most importantly, let's discuss another concern associated with treating SCD. Though consideration for treatment depends on patients fitting the selection criteria, the real obstacle becomes access. It is well known that medical care is costly, and this creates a barrier to individuals receiving adequate and appropriate treatment—especially individuals who have historically been marginalized in society. If we look at Casgevy, for example, "According to the American Academy of Family Physicians, the list price of Casgevy, the first and only CRISPR-based gene editing therapy for SCD is approximately $2.2 million" (Centers for Medicare & Medicaid 2024). When faced with a price tag like this, many eligible and deserving individuals would likely pursue less costly treatments that ultimately prove less effective over the course of a lifetime. It is estimated that over 100,000 Americans are not able to access effective or new SCD treatments due to the high costs involved in receiving these treatments. This all seems ridiculous when you consider that "the lifetime cost of treating SCD is roughly $1.7 million" (PharmaNewsIntelligence 2024), which does not even factor in all related costs such as travel, loss of employment, and productivity while seeking treatment. Though the treatment is costly, it is certainly clear that making the

treatment more cost-effective would ensure more access to deserving individuals, and would prove to be less of a financial burden on all in the long run.

Taking into consideration the need for new and improved treatments for SCD (as well as other conditions that can be treated with gene therapies), it becomes incumbent upon medical practitioners, medical technology companies, and government agencies to find ways to make these therapies affordable and within reach of all those affected and those in most need—not just the financially elite members of society. Currently, this issue of access is not "exclusive to Casgevy; many other cell and gene therapies have an unaffordable price tag, limiting patient access. For example, Hemgenix, a gene therapy for hemophilia B, is listed at $3.5 million. Additionally, Skysona, which treats active cerebral adrenoleukodystrophy, is listed at $3 million" (Centers for Medicare & Medicaid 2024). The average American is barely getting by financially as it is in today's economy, and many also rely on government health insurance plans, which we all know only offer the bare minimum in health care and regularly opt for the "cheaper" solution, treatment, or medication for patients.

What is being overlooked is that those who have the power to make decisions and make changes need to look at the long-term picture. Making these new therapies more accessible will prove to be more cost effective than the routes that are currently taken. To be specific, "Increasing access to these promising therapies will not only help keep people healthy, but it can also lead to savings for states and taxpayers as the long-term costs of treating sickle cell disease may be avoided" (Centers for Medicare & Medicaid 2024). Today's economic climate has many concerned about the rising costs of everything, including medical care, but this now has become a situation of being "penny wise and dollar foolish." A genuine collaboration between policymakers, the medical community, and technology corporations needs to be created so that the disparities in who receives new-and-improved treatments can be adequately addressed. Once this matter is made a priority, "Gene therapies for sickle cell disease have the potential to treat this devastating condition and transform people's lives, offering them a chance to live healthier and potentially avoid associated health issues" (Centers for Medicare & Medicaid 2024). All affected people can have access, regardless of background or status, if we keep in mind what is truly important—that we can alleviate the suffering of others more effectively than we could previously. As this is something we would want for our own families, we should want it for everyone.

Gene therapy treatments for SCD individuals have the potential to give these people the lives that they have always wished for. On May 1 2024, a twelve-year-old boy by the name of Kendric Cromer, became the first commercial patient in the world with SCD to "begin a commercially approved gene therapy that may cure the condition" [(Kolata 2024). Though the Biden–Harris Administration made SCD the focus of their Cell and Gene Therapy (CGT) Access Model as of February 2023, it is now over a year later and there has not been much of an increase in access to cell and gene therapies for those who need it most. The purpose of this model is to "lower health care costs for some of the nation's most vulnerable populations" (PharmaNewsIntelligence 2024), but the model is not scheduled to begin until 2025. Though the Centers for Medicare & Medicaid Services (CMS) will test outcomes-based agreements, it is the success of these agreements that will determine the increase in access to these transformative treatments. On the surface, this all gives a semblance of hope, but the pace of forward movement is not acceptable. This matter needs to be addressed more quickly and those with the power to accomplish this need to act now - not years from now.

In the words of Kendric Cromer, "Sickle cell always steals my dreams and interrupts all the things I want to do" (Kolata 2024). This is the reality faced by millions of SCD sufferers worldwide. Casgevy (and all gene therapies at this point) are considered transformative therapies. They should not be considered a cure as it is still very new, and outcomes are being tracked over many years to

come. However, medical practitioners, medical technology companies and government agencies must do more to increase access to these therapies more quickly. The ability to live a healthy and pain-free life is not only the desire of every individual, but it is a basic human right that cannot be denied and should never be denied for any reason, let alone financial concerns or demographics. We must hold those who impact policy accountable for this.

Thank you.

References

Advancing Health Equity. 2024. https://advancinghealthequity.com/

American Society of Hematology. 2023. "Quantifying the Life Expectancy Gap for People Living With Sickle Cell Disease." https://www.hematology.org/newsroom/press-releases/2023/quantifying-the-life-expectancy-gap-for-people-living-with-sickle-cell-disease#:~:text=Researchers%20found%20that%20the%20average,at%20birth%20(55%20years).

Baldwin, Zachary, et al. 2022. "Medical and Non-medical Costs of Sickle Cell Disease and Treatments from a US Perspective: A Systematic Review and Landscape Analysis." *PharmacoEconomics Open* 6 (4): 469-481. doi:10.1007/s41669-022-00330-w

Blood Disorder Conference: Hematology Conference. 2024. Dublin, Ireland. https://blooddisorders.insightconferences.com/2024

CasgevyTM (exagamglogene autotemcel). Patient Information. (n.d.). https://www.casgevy.com/

Centers for Medicare & Medicaid Services. 2024. "Biden–Harris Administration Announces Action to Increase Access to Sickle Cell Disease Treatments." CMS.gov. https://www.cms.gov/newsroom/press-releases/biden-harris-administration-announces-action-increase-access-sickle-cell-disease-treatments

Columbia University Irving Medical Center. 2023. "First CRISPR therapy approved for Sickle Cell." https://www.cuimc.columbia.edu/news/columbia-impact-first-new-crispr-therapy-approved-sickle-cell

Kolata, Gina. 2024. "First Patient Begins Newly Approved Sickle Cell Gene Therapy." *The New York Times*. https://www.nytimes.com/2024/05/06/health/sickle-cell-cure-first.html?unlocked_article_code=1.p00.qK50.eVAbViaVT4Dm&smid=url-share

Mayo Foundation for Medical Education and Research. 2024. "Sickle Cell Anemia." https://www.mayoclinic.org/diseases-conditions/sickle-cell-anemia/symptoms-causes/syc-20355876

PharmaNewsIntelligence. 2024. "Breaking Down the Cost of Sickle Cell Disease Gene Therapies." https://pharmanewsintel.com/news/breaking-down-the-cost-of-sickle-cell-disease-gene-therapies#:~:text=According%20to%20the%20American%20Academy,)%2C%20is%20approximately%20%242.2%20million.

Rare Daily. 2023. "FDA Approves First Gene Therapies to Treat Patients with Sickle Cell Disease." https://globalgenes.org/raredaily/fda-approves-first-gene-therapies-to-treat-patients-with-sickle-cell-disease/?gad_source=1&gclid=CjwKCAjwoPOwBhAeEiwAJuXRh8JUICaVhoyZKvDHBPcrc2SZCZZUDwGVYHddgF4G0OhoocUKuNmDRoCgVMQAvD_BwE

Reardon, Sarah. 2023. "FDA Approves First CRISPR Gene Editing Treatment For Sickle Cell Disease." *Scientific American*. https://www.scientificamerican.com/article/fda-approves-first-crispr-gene-editing-treatment-for-sickle-cell-disease/

US Food and Drug Administration. 2023. "FDA Approves First Gene Therapies to Treat Patients with Sickle Cell Disease." https://www.fda.gov/news-events/press-announcements/fda-approves-first-gene-therapies-treat-patients-sickle-cell-disease
US National Library of Medicine. 2023. "Beta Thalassemia: Medlineplus Genetics." MedlinePlus. https://medlineplus.gov/genetics/condition/beta-thalassemia/#:~:text=Description,oxygen%20levels%20in%20the%20body.

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Understanding Imperfection: A Spectroscopic Study of Rare Earth Gemstones

Tanner Pilarski and Jonah Wells

Solid crystals are made up of repeating structures often containing imperfections. Spectroscopic techniques allow for characterization of these defects. This project is a continuation of previous studies aimed at examining crystal samples donated to the by the Carnegie Museum of Natural History. This paper examines the symmetry and absorption of these crystals using EPR and UV-visible spectrophotometry. Further understanding of the rotational symmetry and absorption behavior of these gemstones will provide insight into these crystal structures.

Keywords: spectroscopy, imperfections, color centers, crystals, magnetism, radiation

1: Introduction

Rare earth crystals often carry strong aesthetic value, which is why they are often shown in museums or jewelry stores for people to admire or purchase at a high price. In 2000, the Carnegie Museum of Pittsburgh noticed that several of their gemstones were showing visible spots or imperfections referred to as color centers; to investigate this phenomenon, the museum donated some samples to the Allegheny College Biophysics Lab for analysis. The properties which govern these behaviors in color centers offer a wide range of applications in solid state physics such as laser technology and semiconductor materials.

2: Background Theory

2.1 Crystal Origins

Solid crystals are often created in the earth's crust over long periods of time during which atoms are compressed into certain arrangements that make up a crystal's chemical structure. A crystal's physical and chemical properties can also be further affected by the environmental conditions which they are subject to, as seen in Figure 1.

Figure 1: Colored Topaz Samples[1]: Natural state (left), irradiated (right), heated (bottom). Here we see significant differences in appearance due to environmental conditions. However, the natural state still may have imperfections that are not yet visible.

2.2 Lattice Structures

At the atomic level, solid crystals are made up of repeating identical structures that can take many forms. Figure 2 below is an example of a basic sodium chloride (table salt) structure. While this is an ideal structure, often in practice we find that these structures have imperfections such as color centers.[2] A color center occurs when an electron "takes the place of" one of the negatively charged ions, as seen in Figure 2.

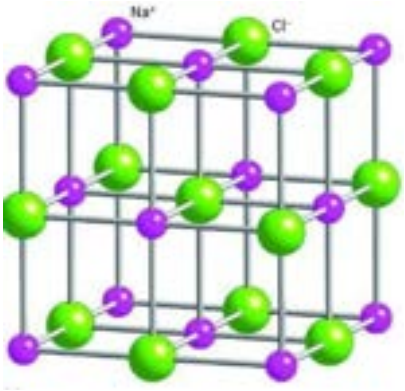

Figure 2: NaCl Crystal Lattice[3]: This diagram shows the crystal lattice structure of NaCl, more commonly known as table salt. The green spheres represent Cl^- ions while the purple spheres represent Na^+ ions.

A color center may appear as one of the green spheres being replaced by an electron, which will then be subject to interactions with different kinds of energy and radiation. These interactions can excite the electron and lead to it emitting colored light in what was previously a transparent crystal.[4] The nature of its interactions and how difficult it is to excite can vary based on how the electron is interacting with surrounding ions. Another common defect can be mineral impurities; when elements of the structure are replaced with other atoms, these impurities can become lodged in interstitial positions. More complex examples of these lattices can be seen in Figure 3.

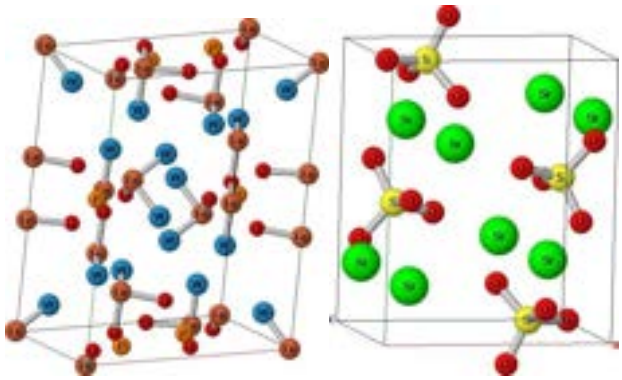

Figure 3: Vivianite (Left)[5] and Celestite (Right)[6] Unit Cell: The figure above shows the most basic repeated structures which make up both celestite and vivianite crystals. The box outlines shown are to give references to axes of orientation. The empirical formulas are as follows: $SrSO_4$ Celestite, and $Fe^{2+}{}_3(PO_4)_2{*}8H_2O$ for Vivianite.

2.3. Experimental Techniques

This project utilized two main experimental techniques: ultraviolet visible spectrophotometry (UV-vis) and electron paramagnetic resonance spectroscopy (EPR). UV-vis is a technique that shines various wavelengths of light into a crystal sample by passing a beam through it and measuring the amount of absorption at different wavelengths. From this technique we can determine how much energy is needed to excite an electron in the lattice using Planck's relation.

Equation 1: Planck's Relation:[7]
$E=hc$

In this equation, E is energy, Planck's constant $h = 6.626 \cdot 10^{-34}\, J \cdot s$, the speed of light $c = 2.998 \cdot 10^{8} m \cdot s^{-1}$, and λ is wavelength in m. This relation allows us to easily equate different wavelength values to their equivalent energy. The energy value can then be divided by the value of an elementary charge ($e = 1.609 \cdot 10^{-19} C$), to give energy in terms of electron volts (eV). The visible light spectrum, 400-700nm, is approximately 1.8-3.3 eV. EPR takes advantage of a well-known and frequently studied property in physics referred to as the Zeeman effect, as seen in Figure 4.[8]

In EPR, the sample is placed in a cavity with a weak oscillating field inside a larger uniform magnetic field that sweeps across a range of values typically within 0–1 Tesla. It is then hit with microwave radiation to trigger absorption, which provides a signal as seen in Figure 4 (bottom on B axis) that we can interpret.

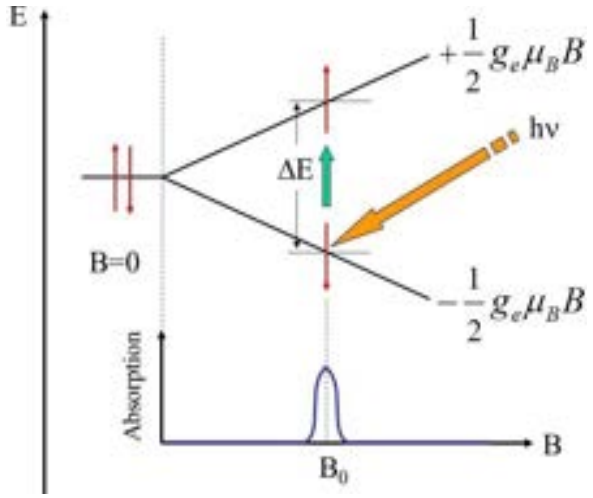

Figure 4: Zeeman Effect[9]: When placed in a uniform magnetic field, the energy states of an electron undergo splitting due to their intrinsic spin. This means that the electron can now be in one of two states and is able to be excited by energy (typically radiation).

The graphing of this data is referred to as *spectra*. These experimental techniques allow us to perceive lattice imperfections before they are visible—even under a microscope or by UV-vis. Due to EPR having very high sensitivity, it is crucial that upon experimentation the machine

must first be run with a test sample such as DPPH (1,1-diphenyl-2-picrylhydrazyl), which emits a large, distinct signal seen in Figure 5.

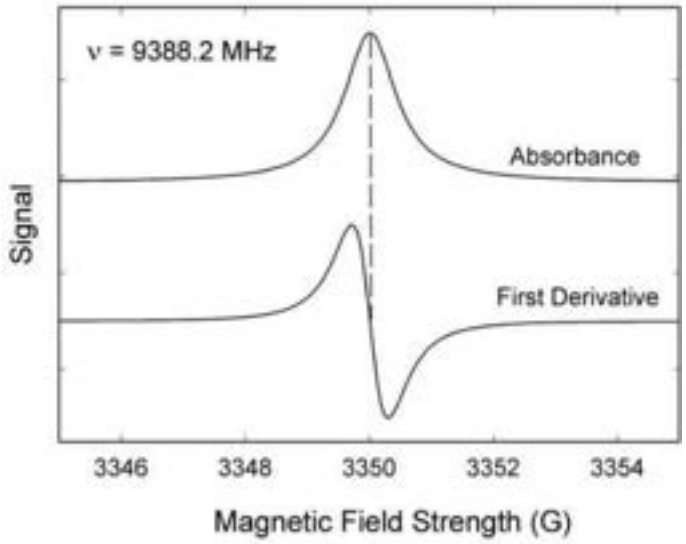

Figure 5: DPPH Spectra[10]: Here we see both the absorbance spectra (top) and the first derivative EPR signal (bottom), the signals recorded by our instrument. Note that the X axis is increasing magnetic field, and the Y is the intensity of the signal. From this data we can calculate g based off of B_0, which here is ~3350 G, and the frequency listed in the top left using the Resonance condition g = 2.00232.

Equation 2: Resonance condition[11]:
$$h\upsilon = g\mu_B B$$

Here, h is Planck's constant (denoted in Equation 1), υ is frequency in Hz, g is a tensor value which can be determined experimentally, the Bohr magneton $\mu_B = 9.27 \cdot 10^{-24}\ J \cdot T^{-1}$—which represents the magnetic moment of an electron—and B_0 is the strength of the magnetic field when a signal occurs. From this, h and μ_B are constants and υ and B_0 are determined experimentally. Thus, EPR spectra can be interpreted to find g where signals occur based on the frequency and magnetic field strength. DPPH is well behaved, as it has a free unpaired electron (see Figure 5). With more complex structures, these signals can become far more complicated. One manifestation of this more complicated signal is hyperfine interactions, which occur when the electron is interacting with many atoms in the structure around it, which can lead to the Zeeman effect energy states becoming more to the effect of small energy "ranges" as opposed to defined levels.

This energy splitting from hyperfine interactions causes multiple signal peaks in very close proximity that can interfere constructively and destructively with one another. When these electrons are well behaved, we can treat them as a particle in a box (as shown in Figure 6) to calculate theoretical energy levels.

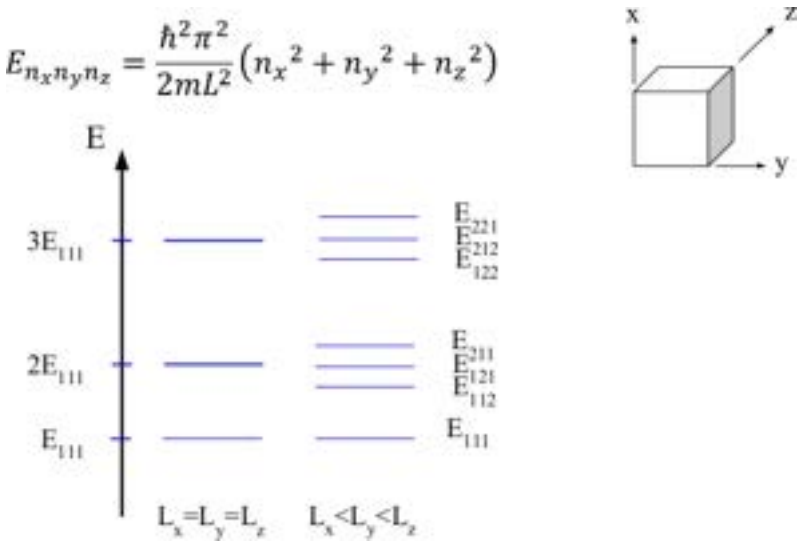

Figure 6: Energy Levels of an Electron in a 3-D Box[12]: The equation (top) calculates energy in this state, based on the 3-dimensional Schrödinger equation. Degenerate (left) and split (right) energy states are shown with energy as the Y axis.

The particle in the box is a well-studied phenomenon in the realm of quantum physics; electrons in color centers agree very well with this model. Figure 6 also allows us to distinguish between the advantages of optical techniques versus magnetic techniques. Optical techniques will pick up differences when the energy states are degenerate (left), while the splitting caused by the Zeeman effect means that EPR will pick up the more complicated energy level interactions shown above (right).

2.4 Crystal Anisotropy

For both techniques, crystal orientation can change interaction, as different orientations through crystals can result in a beam interacting with the lattice structure differently. Conceptually, compare this to thinking of a window and a one-way mirror: no matter what side of the window you stand on, it is clear, making it isotropic, while the one-way mirror's transparency is dependent upon how you look at it, meaning it is anisotropic. Similarly, the one-way mirror crystal properties—not limited to visible properties—are dependent upon the orientation in which they are aligned (see Figure 7).

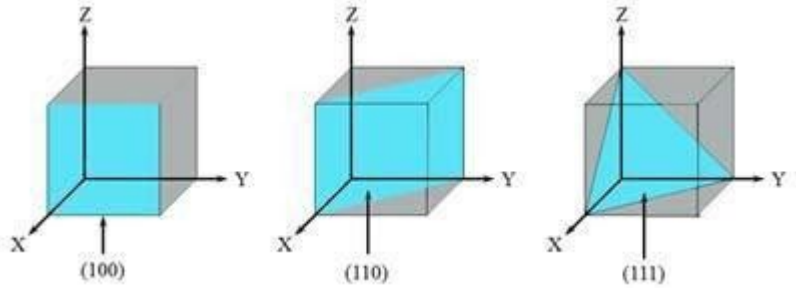

Figure 7: Crystal Face Orientation[13]: Diagram showing how the different orientations of a crystal can expose different faces.

Taking data from multiple angles—especially in EPR—can lead to different absorption spectra. This variation is dependent on how isotropic a lattice is. If a sample is truly isotropic, orientation will not change the spectra, since the greater the change the more anisotropic the structure.

3: Experimental Methodology

3.1 EPR Measurements

Before taking any measurements, we inventory and photograph all the crystal samples with the aid of an XP-3200 series Polarization Microscope and an OptixCam Summit 3.0 microscope camera and take note of the samples we want to test (Figure 8 Left).

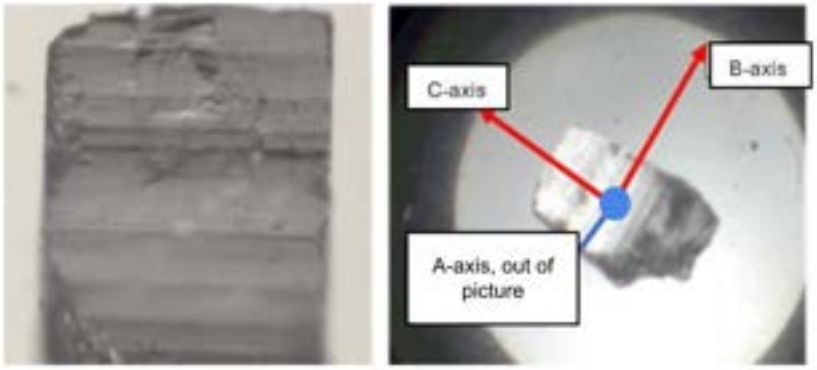

Figure 8: Celestite Microscope and Axes Pictures[14]: (Left) One of the microscope photos taken of the Celestite sample. (Right) A modified microscope photo defining the axes of the Celestite sample.

We compile this combination of inventory and photographs into our own database using Microsoft's Excel and Word. Using Microsoft Word, we modify the pictures of the samples we want to test by establishing three axes (A, B, and C) to aid in orienting each crystal (see Figure 8 Right). By using the previously defined axes and the microscope, we orient each crystal on a custom goniometer-crystal mount system with some vacuum grease as seen in Figure 9 (Left).[15]

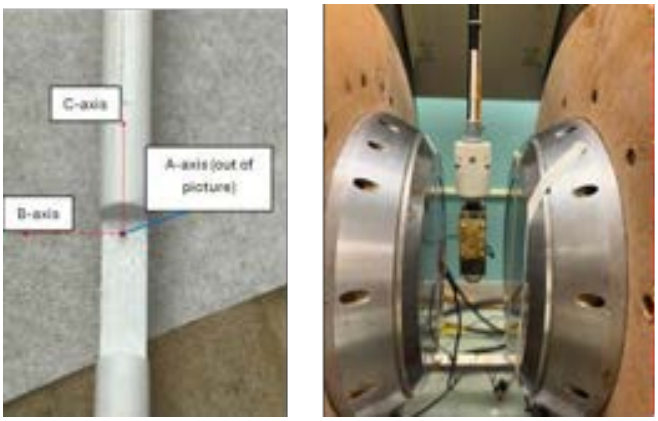

Figure 9: Celestite on Crystal Mount and in Sample Chamber[16]: (Left) Celestite sample mounted in a particular orientation on the goniometer. (Right) Goniometer mounted in the sample cavity of the EPR spectrometer.

Then we turn on the EPR instrument and calibrate the mid-range value using a DPPH sample. After calibration, we mount the goniometer on the sample cavity as shown in Figure 9 (Right). Next, we run the instrument by sweeping the magnetic field over a designated range and time and measure the absorption of microwave radiation by the sample. We then rotate the sample by 5° (the smallest angle measurement marked clearly on the goniometer) and repeat the previous step. We continue this process until an angle of 90° is reached, wherein we remove the sample from the cavity and can either change its orientation or test another sample.

3.2 UV-Vis Measurements

After cleaning the vacuum grease off a sample, we move on to the UV-Vis spectrophotometer. Before we run any samples, we run a clean, blank cuvette to calibrate the Beckman Du 640 Spectrophotometer (Figure 10 Bottom Right). Using the same combination of photos and microscope as the EPR experiments, we mount the samples in a clean cuvette as shown in Figure 10 (Left).

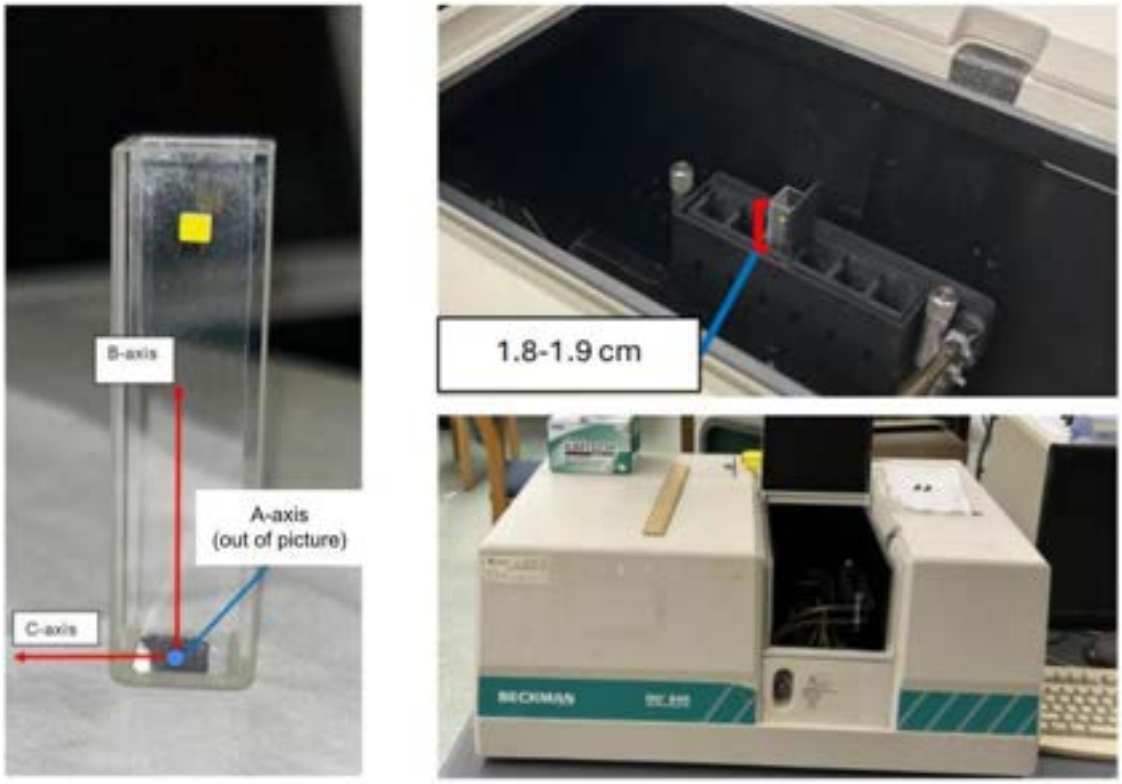

Figure 10: Vivianite Sample Sitting in a Cuvette and Beckman Spectrophotometer[17]: (Left) Shows how a Vivianite crystal is mounted to conduct a UV-Vis trial at a defined orientation. (Top Right) Shows how the cuvette was mounted in the sample holder. (Bottom Right) Photo of the entire Beckman Du 640 Spectrophotometer.[18]

Since our samples are small, we place the cuvette in the sample holder so that the top of it (depending on how small the sample is) sits 1.8-1.9 cm above the top of the sample holder so that as much of the source can pass through each sample as possible (see Figure 10 Top Right). The spectrophotometer is then run over a set wavelength range (190-1100 nm). Once this is done, the sample is removed from the chamber and re-oriented or swapped out for another sample. The data

collected is stored on an external laptop via a Microsoft Excel document and later transferred to personal computers for analysis.

4: Results

4.1Celestite

Through measurements using the techniques described in the methodology section, intriguing results are acquired. For example, one of the celestite ($SrSO_4$) sample with no visible coloration produced the EPR spectra seen in Figure 11.

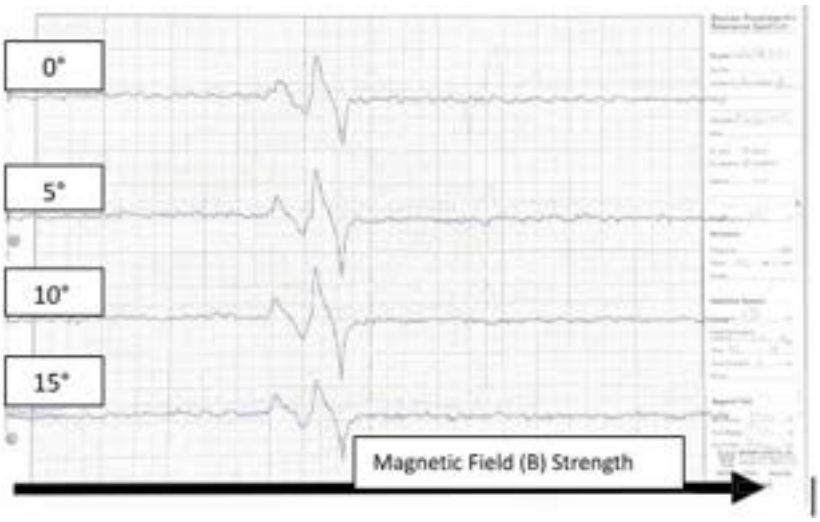

Figure 11: **Celestite Cut 1 EPR Spectra**[19]: These Celestite EPR spectra show the two major signals from the sample that are seen when the sample is rotated clockwise in 5° increments.

Two signals are apparent in this data, indicating damage within the crystal we cannot yet see with the naked eye. The signals in these spectra change intensity, sharpness, and even fully disappear at certain angles, but do not shift very much. This is further shown by the data in Figure 12, which has no indications of periodicity in the signals. Note that the changes in B seen on the y-axis are very small in both graphs of Figure 12.

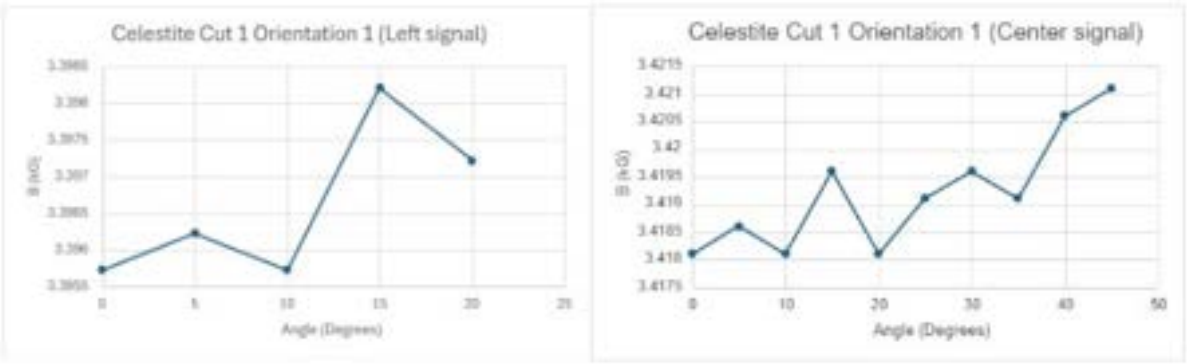

Figure 12: Celestite Cut 1 Signal Periodicity[20]: Graphs of the magnetic field strength at which each signal is seen versus the angle at which the spectra were taken (0-90°). The left signal is seen at far fewer angles than the center signal (the center signal is the one seen on the right in Figure 11).

2.2 Vivianite

Although no significant evidence of periodicity is found in this Celestite sample, the same cannot be said for the Vivianite sample we tested. Unlike the Celestite crystal, this crystal has a deep blue to black color depending upon the intensity of the light shining through it. In Figure 13, we see the signals from the Vivianite sample confirming the damage within its structure.

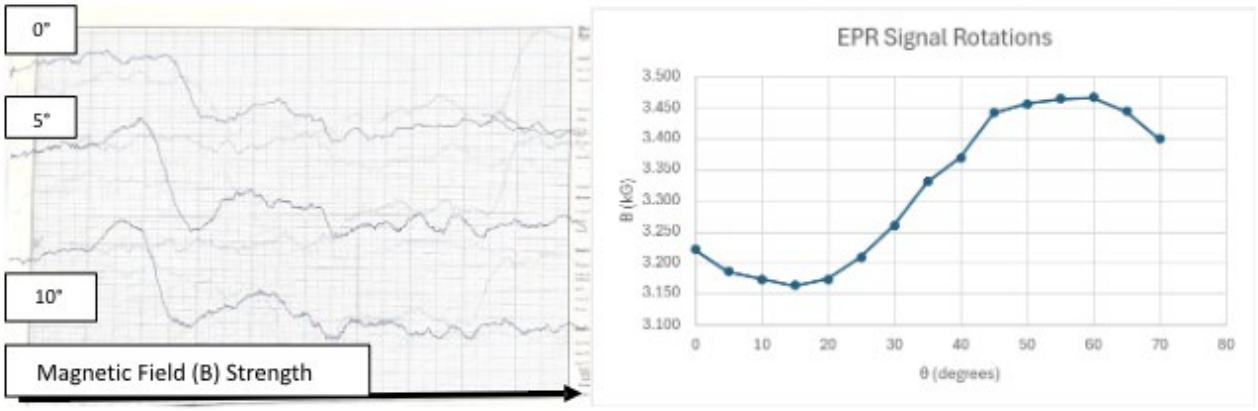

Figure 13: Vivianite EPR Spectra and Periodicity[21]: (Left) These Vivianite EPR spectra show how the signals shift and strengthen/weaken as the sample is rotated clockwise in 5° increments for a specific orientation. (Right) This graph shows the angle at which the sample is rotated (clockwise) versus the magnetic field strength at the center of the large drop seen at the left of the EPR spectra.

Like Celestite, there is also a change in intensity of the signals within Vivianite's data. The intensity (primarily of the large drop on the left side of Figure 13) changes with rotation, and some signals disappear at around 70° (indicated by the data on the right side of Figure 13 only covering 0-70° instead of 0-90°). Absorption data for Vivianite can be seen in Figure 14.

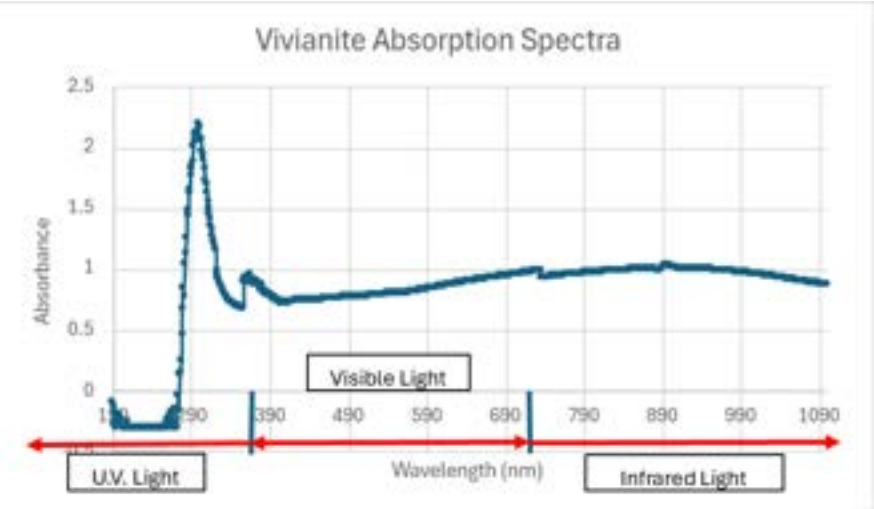

Figure 14: **Vivianite UV-Vis Absorption Data**[22]: This graph shows the absorption spectra of the Vivianite crystal in a specific orientation. There is a clear absorption peak in the U.V. range with a width spanning 280-325 nm. The two abrupt drops seen at higher wavelengths are false absorption lines caused by noise in the instrument.

From this data, it is apparent that this Vivianite crystal has an absorption peak at ~290 nm. This could be another indication of damage as is the EPR signals, but it could also be due to the electron transitions of the Fe (II) atoms in its lattice (see Discussion).

4.3 Hyperfine Interactions

Upon closer observation, both the Celestite and Vivianite EPR data appear to have noise within their signals. This could be the result of hyperfine interactions or overlapping signals that require more research to be better understood (see the Future Work section for more details).

5: Discussion

5.1 Celestite Analysis

The structure of Celestite ($SrSO_4$) seen in Figure 3 can be used to aid in understanding the results of our experiments. The Sr^{2+} ions in this lattice bond to the two negatively charged O atoms in the SO^{2-} ions to balance the charge of the mineral. This means that none of the atoms of a pure crystal of Celestite will have unpaired electrons, making it invisible to EPR. However, our data shows two pronounced signals (Figure 11) where there should be none. In this structure, some of the oxygen atoms may be missing or misplaced, likely due to long exposure times to radiation while being stored under intense museum lights. The holes left behind by the oxygen atoms can be occupied by electrons and form color centers that could produce the signals we see within the data.

5.2Vivianite Analysis

A similar phenomenon is observed with the Vivianites sample. The structure of Vivianite as shown in Figure 3, apart from the Fe (II) ions, it does not have any unpaired electrons to produce signals. In addition, the crystal has a visible coloration that would not be present in a pure sample.[23] The source of these signals is likely color centers within the structure of the sample indicating the damage we are already seeing based on the coloration of the crystal. Electrons could be occupying spaces where negatively charged oxygen atoms are missing in the structure. These holes could have been produced in a similar way to what was proposed to have caused the holes in the Celestite structure. Like Celestite, these signals are observed to change intensity throughout the rotation of the sample, but they also shift back and forth.

The UV-Vis absorption spectrum of the Vivianite sample is another subject of investigation. Its absorption, as shown by Figure 14, has a peak in the UV range. This peak is maintained for all the orientations of the crystal that were tested, but at varying intensities (ranging from ~1.1-2.0 absorbance). This absorption could be caused by the color centers mentioned above, but it could also be a result of electron transitions within the Fe (II) atoms in its lattice. These electrons can have transition energies in the range of 3.3-6.9 eV.[24] The absorption peak in the Vivianite data ranges from ~280-325 nm and by using the relationship for the energy of a photon given in Eq. 1, this gives us an energy range of 3.8-4.4 eV.

5.3 Crystal Anisotropy

As mentioned previously, these signals are not constant throughout the rotation of either of our samples. This is an indication of the anisotropy that is present within crystals. As the faces of each sample change orientation within the magnetic field in EPR or path of the source beam in UV-Vis, different properties are seen. For Vivianite, this is supported by the periodicity of the signal shown by the graph to the right in Figure 13. For Celestite, although there is no periodicity in the shifting of the signal (see Figure 12), later angles of the data for a different orientation of the crystal show that at around 85-90°, the signal starts to reappear. This could be an indication of the periodicity typically seen within anisotropic crystals, but further research is required to support this claim.

5.4 Error Analysis

Throughout this study, many factors have limited our ability to be precise with certain processes. For example, the goniometer we are using, while helpful, is not perfect. It only has a precision of 5° and the metal ball bearings used to rotate the sample are magnetic so it can often be difficult to fit the goniometer to the sample cavity while keeping the crystal centered. Another challenge arose when trying to mount the crystals in the UV-Vis spectrophotometer. Since the cuvettes are much larger than our samples, it is difficult to accurately orient the samples within them. The crystals are also much smaller than the slits in the sample holder, increasing the difficulty of aligning the sample in the path of the beam. On top of this, the instrument is old, and the lamps are starting to reflect its age (the UV lamp had to be exchanged to improve experimental accuracy). As a result, the spectrophotometer is often unreliable under 300 nm, so potential signals in this range may go unnoticed. Other factors such as small traces of vacuum grease on our samples could have also impacted the accuracy of our results.

6: Future work

Two goals of this study are to assemble a local database of our crystal samples and to identify topics for future work on this project. This way, unexplored samples and orientations of the crystals held in the Allegheny College Biophysics Lab can be tested and compared to previous data. As briefly mentioned in the Results section, the noise within these signals is apparent and testing the crystals covered in this study (and any of the other samples) at low temperatures using the lab's cryostat could prove useful in resolving this hyperfine interference observed in our data. Doing so may also reveal additional signals that are not present at room temperature. Improvements made to the goniometer such as replacing the ball bearings with a non-magnetic material, improving the accuracy of the angle measurements, or designing a more secure and specific mounting mechanism will allow any future data to be more accurate and consistent over time. Taking the time to analyze or simulate data using software will aid in identifying impurities and analyzing the structure of these crystals.

7: Conclusion

Through EPR spectroscopy and UV-vis spectrophotometry on Celestite and Vivianite, we discovered we were able to make insights into the nature of what defects are occurring in their structures. Vivianite exhibited clear anisotropic properties based on EPR data. Celestite showed significant evidence of hyperfine interactions being present in its spectra, warranting further study at colder temperatures. This study proved a foundational piece of this project going forward for other research students to continue carrying on in the future. From absorption data collected, there is significant evidence to suggest that UV-radiation from prolonged exposure to intense museum display lights is the root cause of color center defects.

Notes

[1] California Institute of Technology, "Colors from Ionizing Radiation," Minerals Colored by Irradiation, http://minerals.gps.caltech.edu/COLOR_Causes/Radiate/index.htm.
[2] C. Kittel, *Introduction to Solid State Physics* (New York: Wiley, 1976).
[3] D. T. Petasis, "Phys-210: Core Concepts in Physics III: Introduction to Quantum Mechanics," class lectures, Allegheny College, Spring 2024.
[4] F. C. Brown, *The Physics of Solids: Ionic Crystals, Lattice Vibrations, and Imperfections* (New York: Benjamin, 1967).
[5] Hudson Institute of Mineralogy, "Celestine: Mineral Information, Data and Localities," Mindat.org, https://www.mindat.org/min-927.html.
[6] Hudson Institute of Mineralogy, "Vivianite: Mineral Information, Data and Localities," Mindat.org, https://www.mindat.org/min-4194.html.
[7] Petasis, "Phys-210."
[8] D. T. Petasis, *EPR Fundamentals* (2022).
[9] Petasis, *EPR Fundamentals*.
[10] Rajnandini Rajnandini and Doros Petasis, "EPR Investigations of DPPH and MN(II)CL2/H2O," *International Journal of Advanced Research* 11 (2023): 1273–1278, https://doi.org/10.21474/IJAR01/17645.
[11] Petasis, *EPR Fundamentals*
[12] Petasis, "Phys-210."
[13] Crystal Scientific, "Crystal Orientation," https://crystal-scientific.com/xtal_orientation.html. (Image only.)
[14] Jonah Wells and Tanner Pilarski, data, graphs, and images, created by the authors.
[15] T. Lubinsky, "X-Band EPR Studies of Paramagnetic Defects in Gemstones" (undergraduate thesis, Allegheny College, 2019).
[16] Wells and Pilarski, data, graphs, and images.
[17] Wells and Pilarski, data, graphs, and images.
[18] Beckman Instruments, Inc. (1995). *DU Series Spectrophotometer Operating Instructions* (Manual 517300C).
[19] Wells and Pilarski, data, graphs, and images.
[20] Wells and Pilarski, data, graphs, and images.

[21] Wells and Pilarski, data, graphs, and images.
[22] Wells and Pilarski, data, graphs, and images.
[23] Hudson Institute of Mineralogy, "Vivianite."
[24] Lei Zhang, Shunsuke Kashiwakura, and Kazuaki Wagatsuma, "Boltzmann Statistical Consideration on the Excitation Mechanism of Iron Atomic Lines Emitted from Glow Discharge Plasmas," *Spectrochimica Acta Part B: Atomic Spectroscopy* 66, nos. 11–12 (2011): 785–792, https://doi.org/10.1016/j.sab.2011.10.002.

References

Ashcroft, Neil, & N. David Mermin. 2006. *Solid State Physics*. Cengage Learning.

Beckman Instruments, Inc. 1995. *DU Series Spectrophotometer Operating Instructions* (Manual 517300C). Beckman Instruments, Inc.

Brown, Frederick. *The Physics of Solids: Ionic Crystals, Lattice Vibrations, and Imperfections*. 1967. Benjamin.

California Institute of Technology. 2016. "Colors from Ionizing Radiation." Minerals Colored by Irradiation. http://minerals.gps.caltech.edu/COLOR_Causes/Radiate/index.htm.

Crystal Scientific. 2011. "Crystal Orientation." https://crystal-scientific.com/xtal_orientation.html. (Image only.)

Fritsch, Emmanuel, & George R. Rossman. 1988. "An Update on Color in Gems. Part 3: Colors Caused by Band Gaps and Physical Phenomena." *Gems & Gemology* 24 (2).

Hudson Institute of Mineralogy. 2025. "Celestine: Mineral Information, Data and Localities." Mindat.org. https://www.mindat.org/min-927.html.

Hudson Institute of Mineralogy. 2025. "Vivianite: Mineral Information, Data and Localities." Mindat.org. https://www.mindat.org/min-4194.html.

Kittel, Charles. 1976. *Introduction to Solid State Physics*. Wiley.

Lubinsky, T. 2019. "X-Band EPR Studies of Paramagnetic Defects in Gemstones." Undergraduate thesis, Allegheny College.

Petasis, Doros. 2024. "Phys-210: Core Concepts in Physics III: Introduction to Quantum Mechanics." Class lectures, Allegheny College.

Petasis, Doros. 2022. *EPR Fundamentals*. De Gruyter.

Rajnandini, Rajnandini, & Doros Petasis. 2023. "EPR Investigations of DPPH and MN(II)CL2/H2O." *International Journal of Advanced Research* 11: 1273–1278. https://doi.org/10.21474/IJAR01/17645.

Tipler, Paul A., & Ralph A. Llewellyn. 2008. *Modern Physics*. W. H. Freeman.

Wells, Jonah, and Tanner Pilarski. Data, graphs, and images. Created by the authors.

Zhang, Lei, Shunsuke Kashiwakura, & Kazuaki Wagatsuma. 2011. "Boltzmann Statistical Consideration on the Excitation Mechanism of Iron Atomic Lines Emitted from Glow Discharge Plasmas." *Spectrochimica Acta Part B: Atomic Spectroscopy* 66 (11–12): 785–792. https://doi.org/10.1016/j.sab.2011.10.002.

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Getting to the Point: The Development of the Javelin

Jonah Wells

A javelin is a light spear designed to achieve the furthest possible throwing distance. The javelin began as an adaptation to spears for better ranged weapons in war and now has its own prolific Olympic sport. Over time, the javelin has changed drastically as it experiences a never-ending parley between optimization of throwing distance and regulation. This study aims to elaborate on the physics underlying the aerodynamics and flex of javelins as they soar through the air.

Keywords: javelin, Olympics, elastic deformation, drag, laminar flow, lift, flex

Javelin is a throwing event found in most track and field meets. The competition involves athletes charging down a runway and giving their best attempt at turning their body into a human slingshot. A good throw or personal best is often accompanied by a barbaric cry or scream for the athlete to savor the moment. The history of the javelin throw is long and complex. The action of throwing a spear-like stick has existed since the Stone Age and has come a very long way since. Many athletes spend numerous hours perfecting the many idiosyncrasies and elaborate biomechanics of the javelin throw. Just as the mastery of the throw is a complex process, so too is the design of the javelin itself.

Historical Background

Modern javelin implements are complex in their weight distribution, aerodynamics, and more. They have come to this point through a long progression of advancement and regulation. The javelin has a strong history tracing all the way back from its early development to its modern form. The first true usage of the javelin began in ancient Greece with the Mycenaeans, and then later with the Romans (Yachtingnut 2012). The javelin was originally designed as an offensive weapon and used in favor of the spear as it was lighter and could be thrown rather than thrust, therefore allowing long distance attacks against an enemy. These implements were made of wood with a sharpened metal or stone tip. The javelin saw its introduction to the sporting world in sporting games held in ancient Greece. Ancient Greek javelins were far lighter than their military counterparts as they had the objective of reaching the greatest distance.

The javelin was reintroduced into the sporting world in some Nordic countries in the late 19th and early 20th centuries. Soon, it became a part of the Olympic games with its first sighting at the 1908 London games. The IAAF (International Association of Athletics Federation) was soon introduced in 1912 to standardize many Olympic events—including the javelin throw (Martin 2022). This period led to a long, consistent increase in the distances athletes could achieve.

The regulations surrounding javelin changed marginally until 1986 when Uwe Hohn threw a then world record 104.8 meters, thus prompting safety concerns. Due to the consistent increases in

throw distances (as seen in Figure 1), the stadiums where competitions were held were quickly becoming too small. A change to the javelin implement is far cheaper than rebuilding all the stadiums, thus a redesign process began. The changes elicited new rules in 1992—ones that are still used to this day. In common phrase, the change in javelin construction is referred to as "old rules" for pre-1992 javelins and "new rules" for modern javelins. There were rapid changes in minor alterations of the javelin from 1988–1992, yet this timeframe is rarely talked about in detail in many javelin circles due to its brevity. This long series of changes shaped the current javelin varieties used in competition today.

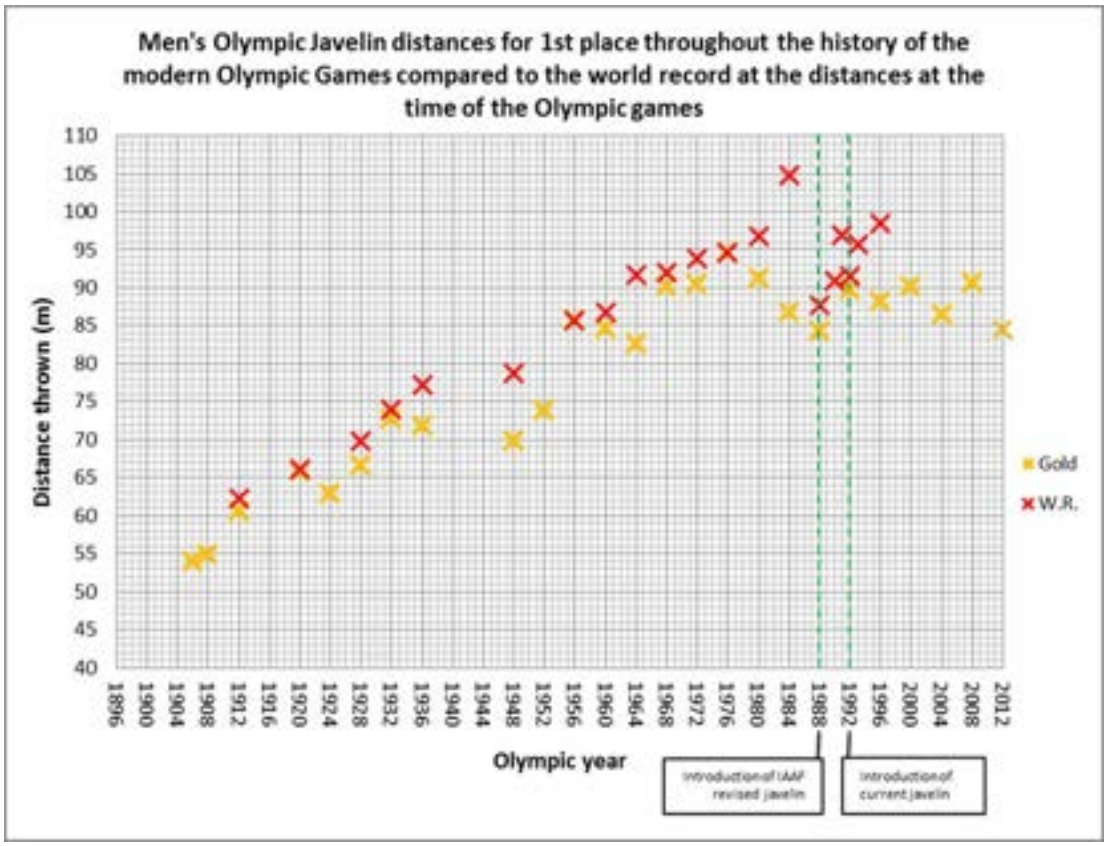

Figure 1: Top Javelin Distances 1896–2012 (Yachtingnut 2012): This chart shows the progression of gold medal distances and world records over time.

Modern Javelins

The design and material of the javelin has greatly changed. Modern javelins are made of aluminum, steel, or carbon fiber (although some are made of composite, this is uncommon). The tip of the javelin is commonly made of steel. However, some competitions—mainly youth competitions—use a rubber tip as opposed to steel for safety reasons. The handle consists of rope held on by glue. Aluminum, steel, and carbon are notable for their strength and stiffness while having good strength to weight ratios, especially carbon fiber. Modern javelins come with a "distance rating"; this number is effectively the optimal flight distance for it to turn over and stick at

about a 5-degree angle (Just Fly Sports 2025). It must be noted that for a javelin throw at a collegiate or higher level to count, the steel tip must contact the ground before any other part of the javelin.

Modern javelins must also adhere to strict length, weight, diameter, and balance requirements (as shown in Figure 2). Regardless of the javelin's material characteristics, it must follow these guidelines.

Figure 2: **Standards for Javelins used in Competitions (TDK Tech-Mag)**.

Physics Basics

A javelin's physical properties in aerodynamics and material properties greatly influence its effectiveness. Materials can undergo elastic and plastic deformations (Poynor 2025). Elastic deformations undergo stress that does not pass a critical point of failure and the material returns to its original state with no permanent deformation. For example, bending a plastic ruler and seeing it snap right back into place. Compare this to a plastic deformation, which is not reversible. Take the wing of an airplane—it is essential that it is able to withstand sudden winds and force, and must be able to experience an elastic deformation; a plastic deformation would result in a critical failure and a plane crash. With a javelin the stakes are not as high, but for longevity a javelin must be able to undergo substantial stress without plastically deforming.

Javelins undergo a substantial amount of drag during flight, especially since being widened in 1992 which induces a substantial amount of drag force. Drag is the resistive force induced by a fluid (air can be considered a fluid as it behaves similarly to a fluid). These aerodynamic effects can be simulated in CFD (computational fluid dynamics) simulations, where air is modeled as fluid particles (as seen in Figure 3).

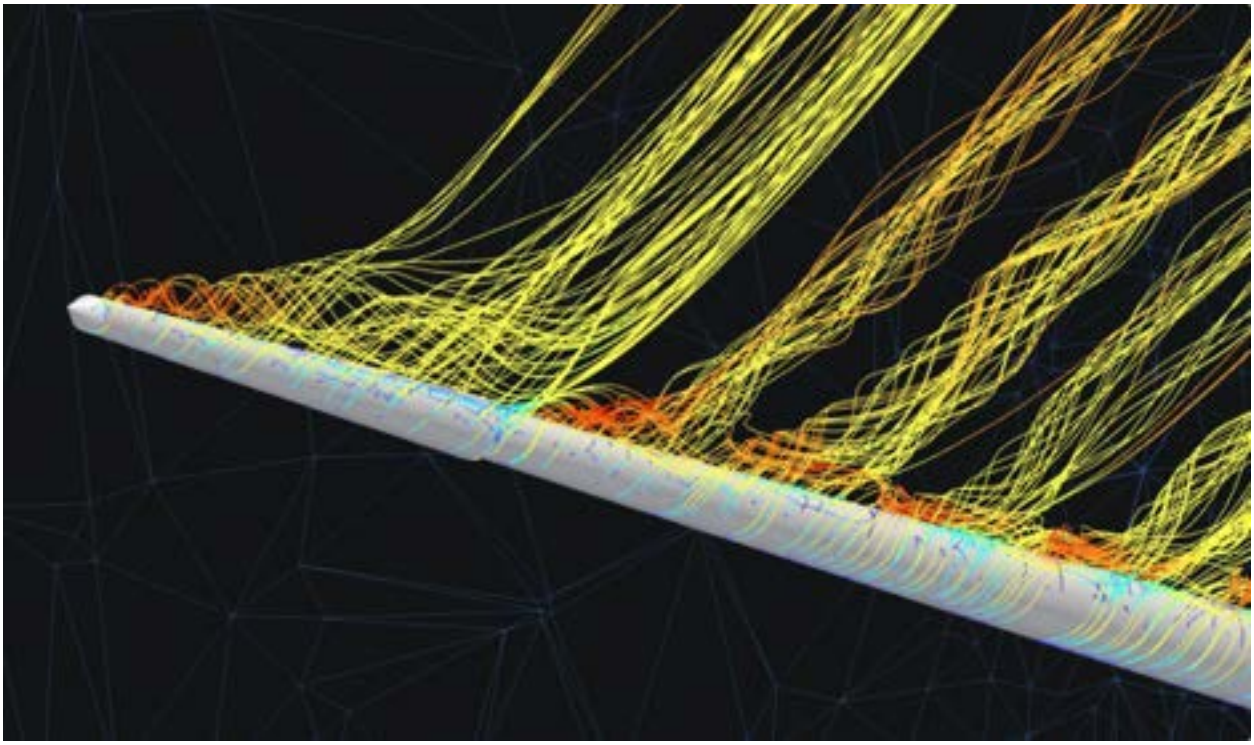

Figure 3: CFD Simulation of Javelin Aerodynamics (Chitta, Varun, and Lim 2024): Simulation of terminal and laminar flow of air around a javelin.

Terminal and laminar flow are properties of any fluid. Laminar flow is an orderly parallel flow of fluid molecules and enables a low drag environment (Veritasium 2020). Terminal flow, by contrast, is characterized by its disordered flow, and is far more disruptive in slowing a projectile by inducing drag forces.

Javelins in Flight

In any physics introductory mechanics course, you will find yourself doing a two-dimensional projectile motion problem where a 45-degree angle is optimal for a projectile to travel the furthest possible distance. Upon throwing a javelin, you will very quickly realize that a 45-degree angle throw will result in a disappointing distance. This discrepancy is due to discounting drag and air resistance as negligible forces, and assuming the projectile is launched from a height of zero. Due to both drag and lift effects, for a javelin the optimal angle for flight is approximately 36 degrees (Just Fly Sports 2025).

When accounting for drag, lift, environmental factors such as wind, and other dynamics of a throw, a javelin's aerodynamics prove to be very complicated. Due to the angle of attack seen in Figure 4, the javelin to some extent is hitting the air horizontally—inducing drag and thus an area of pressure drag behind the main body of the implement. Since the 1992 rule change and the widening of the javelin, this drag force has become substantially stronger due to a wider tip. This increase in width has resulted in a greater pressure drag being induced behind the javelin; the higher the angle of attack, the greater the magnitude of this effect. The tremendous energy transfer to the javelin initiates vibration of the javelin at the moment of release. The acceleration of the javelin during

delivery has a mean value of forty times gravitational acceleration and the large forces involved make javelin vibrations inevitable (Maheras 2013). Their amplitude depends on the timeliness, mass, and geometry of the shaft. This is where the elastic nature of a javelin's materials are essential (see Figure 5). The flexure and vibration of the javelin also subtly affect the throw's distance. A moderately flexible javelin is easier to throw, and one that quickly dampens flex and vibration after release flies farther. A stiffer javelin, capable of holding up to extreme forces without plastic deformation, is essential, but for optimum performance the material must be as stiff as possible to achieve a further flight.

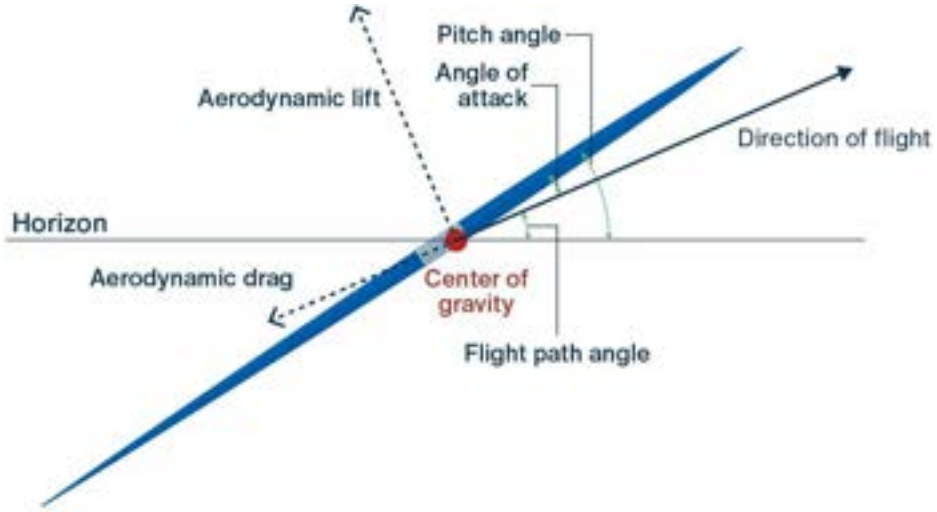

Figure 4: Javelin Flight Angles and Forces (TDK Tech-Mag 2025): Note the directions of aerodynamic lift and drag lift can keep the javelin in the air longer, allowing it to "float" longer than a projectile without lift.

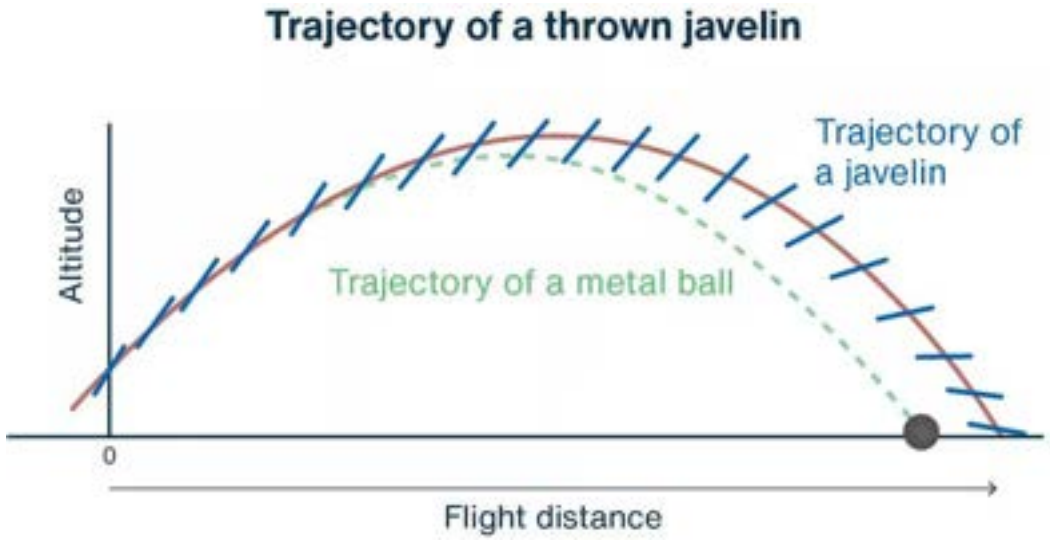

Figure 5: Trajectory of a Thrown Javelin (TDK Tech-Mag 2025): When compared to the case of a metal ball, the javelin flies substantially differently due to the effects of drag and lift.

Looking Forward

While the dimensions, shape, weight, and center of gravity of a javelin are specified in detail, the internal structure and mass distribution are not. How flex and vibration affect flight distance have yet to be fully researched, so, depending on materials and design, exceeding one hundred meters may come within reach for the world's top athletes.

Conclusion

Javelin has an incredibly rich history, from military applications to sporting events. The sport is incredibly influenced by physics principles in material science and aerodynamics. Through physics principles, the flight of a javelin can be understood to a much greater extent. The stiffness of a javelin, paired with the effects of drag from the attack angle it is thrown, greatly affect the distance and characteristics of its flight path. Through continuing development of materials and aerodynamics, perhaps the design of the javelin will again have to be modified to keep it within the stadiums.

References

Chitta, Varun, and Jason Lim. 2024. "What CDF Simulation Teaches Us About the Aerodynamics of a Javelin Throw." Luminary, September 25th. https://luminary.ai/resources/what-cfd-simulation-teaches-us-about-the-aerodynamics-of-a-javelin-throw/.

Just Fly Sports. "Optimal Javelin Flight: Physics and Fixes." Accessed 2025. https://www.just-fly-sports.com/optimal-javelin-flight-physics-and-fixes/.

Maheras, Andreas. 2013. "The Javelin: Basic Javelin Aerodynamics and Flight Characteristics (Part 2)." *Techniques for Track and Field & Cross Country* 7 (2): 22–6.

Martin, Hannah. 2022. "From Held to John and Beyond – The Evolution of the Javelin." World Athletics, October 8th. https://worldathletics.org/news/feature/history-javelin-implement-specifications.

Poynor, Adele. 2025. "Allegheny College PHYS-480: Current Topics in Materials Physics." Unpublished course materials, Allegheny College.

Seo, Kazuya, et al. 2023. "Measurement of Aerodynamic Force and Moment Acting on a Javelin Using a Magnetic Suspension and Balance System." *Scientific Reports* 13(391). https://doi.org/10.1038/s41598-023-27534-2.

TDK Tech-Mag. "Leveraging Aerodynamic Lift for a Great Hurl." Accessed 2025. https://www.tdk.com/en/tech-mag/athletic/008.

"Turbulent Flow is MORE Awesome Than Laminar Flow." Posted June 11, 2020, by Veritasium. Youtube, 18 min., 31 sec. https://www.youtube.com/watch?v=5zI9sG3pjVU.

Yachtingnut, Sean. 2012. "The Story of the Javelin—Bringing it Back Down to Earth." Engineering Sport, September 21. https://engineeringsport.co.uk/2012/09/21/the-story-of-the-javelin-bringing-it-back-down-to-earth/.

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The Dieter P. Lotze Memorial Essay Competition Fund was established by the late Barbara Lotze, Professor Emerita of Physics, in remembrance of her late husband, Dieter P. Lotze. Professor of Modern Languages Dieter Lotze taught German language and literature at Allegheny for more than 26 years. This prize is intended to recognize not only his achievements as a teacher and scholar, but also his collaboration with Barbara Lotze in an attempt to enhance communication between their different academic disciplines.

This essay was awarded the 2026 Dieter P. Lotze Memorial Essay Prize.

Circumlocution: The Applicability of a Language Strategy to STEM Fields

Nickel Spartz

Introduction

As a fourth-year biochemistry and Spanish double major at Allegheny College, I have thought closely about the connections between disciplines in my coursework, research, and conversations with others. I started biochemical research in my first year of undergraduate studies, and since then I have worked in labs across the country and even in Spain. My Spanish learning experience has undoubtedly influenced these lab experiences as I consider the mental training that studying a language has provided me. Most critically, the translational practice of circumlocution has granted me a level of perseverance, new ways of approaching complex challenges, and strategies for communicating with a general audience.

Circumlocution is a language technique I discovered early on in my practice of a foreign language. As I learned conversational skills in Spanish, my instructors encouraged me to remain situated within the language so that my mind could begin to build mental connections and pathways in Spanish. As one could imagine, these conversational scenarios often stuttered to a standstill in moments when I was left without the correct word or phrase to describe an object or experience due to my limited vocabulary. Instead of switching to English to ask for a direct translation, my teachers and professors encouraged me to describe the object in Spanish. Then, working backwards from definitions, characteristics, and defining traits that I could provide, we would arrive at the word I for which I had been searching.

The English definition provided by the Merriam-Webster dictionary for circumlocution is negative, calling the logical process a "use of an unnecessarily large number of words to express an idea" ("Circumlocution"). In this essay, I provide a clear argument for the positive impact that circumlocutionary practices can have on language learners, and how those positive impacts translate into their work in other fields, particularly those situated under the greater STEM umbrella.

Circumlocution in a Second Language

Circumlocution became a valuable asset to me during my semester in Spain. My sweet, adorable, overbearing, abuela of a host mother, Lola, did not speak more English than the few Elvis Presley lines that she would serenade me with on a regular basis. While charming, the "king of rock and roll" did not prepare Lola to speak fluent English, and, as such, I was only able to communicate

with her in Spanish. The first week was rough. That week both Lola and I came to the realization that my Spanish was nowhere near good enough for effective communication. I must give Lola credit though; she had a great level of patience. Over meals together, she and I began to find our stride as I leaned into circumlocution when I struggled to find the word I needed. I felt my mind building bridges in Spanish that expanded my ability to express myself.

Through the roundabout pathways circling out into broader regions of my brain, I was able to begin engaging in lively debates and deeper conversations with Lola. We discussed gender and sexuality, politics, the limitations of free speech, and so much more over meals. I rarely had the full appropriate lexicon to approach these conversations, but through circumlocution, I shared my viewpoints with her. I remember one conversation clearly. We were watching an afternoon talk show, similar to *The View*, and a guest woman who was recently widowed joined the hosts. The woman was discussing her recently published book on the abusive environment her husband had fostered in their relationship while he was alive. I was surprised to hear Lola vehemently insult the woman for not allowing her husband to rest in peace. I disagreed with her, but did not have the legal or direct language to discuss domestic abuse in Spanish. However, I was able to describe my belief that the only way for the cycle of domestic violence to be broken is through the bravery of women publicly sharing their stories and serving as examples for others currently suffering in similar ways. While Lola still disagreed with me, my victory in that moment was that she saw my perspective and acknowledged that she understood my point of view. Many other such instances of debate happened between us over my five months with her, but I am especially proud of that moment.

After my return from Spain, I continued using my circumlocution in my weekly standing meetings with my Spanish comprehensive project advisor, Profesora Herrera. In these meetings, we discuss my progress and often work through my terribly messy drafts of an ambitious project that combines my two disciplines into a single investigation. As a trained linguist, Profesora Herrera often needs me to work with her to understand the biochemical aspects of my thesis. It is during these conversations that we turn to the stuffed alligator that resides on her desk.

The alligator provides semiotic translational value to our conversations as we work through more complicated biochemical knowledge. I remember a conversation on curing bacterial strains of antibiotic resistance that was particularly entertaining. As I walked myself in circles trying to explain the concept in Spanish, Profesora Herera set the alligator down in front of me to use as I described the process. Now I had a visual aid that altered the way I was trying to explain the concept. I described how the alligator was defenseless against antibiotics, but with a pencil we dubbed as a sword, it could defend itself. However, that pencil was comically taller than the alligator itself, so I used that to my advantage, describing how the sword-pencil was heavy and made the alligator lag behind. Thus, I demonstrated that having the sword was an advantage for the alligator while facing a threat, but that it became a hindrance when not defending itself—just like bacteria struggle to reproduce when they have more genetic material (resistance plasmids) to replicate and split between daughter cells. From there, Profesora Herrera was able to explain the concept back to me, thus confirming I had effectively communicated the idea to her. Explaining curing bacteria of antibiotic resistance with a stuffed alligator and a pencil exemplifies how my work in Spanish has taught me

how to approach challenges from different angles and how to develop effective cross-language, cross-cultural communication.

Circumlocution in a Laboratory Setting

The circumlocutional practices fostered by my study of the Spanish language have direct applicability in laboratory settings. As was illustrated in the example above, circumlocutionary thinking encourages outside approaches to challenges. My experience with scientific research is that it regularly produces results that are unexpected or that may appear inconclusive until I approach the data from different angles.

My first summer of research was a frustrating experience. I spent seven weeks running the same experiment without getting the results I expected to see. My advisor and I tried altering the protocol repeatedly to no avail; no matter what we did, the results did not come. Finally, taking a step back and looking at the project as a whole, we decided we had to start over and track each process to ensure all steps went according to plan. In my last week, we discovered that the results we were receiving were a result of an incomplete first step. That experience showed me the value of approaching challenges from different perspectives. I do not know if I knew then, but my language learning would continue to hone that skill over my next three years.

During my second summer in an early cancer detection research lab, I remember sitting down and feeling defeated once again as I stared at my data. The proteins that my data had identified in all of the samples had nothing in common with one another. In other words, I had hit a dead end. The lab often searched for patterns in their data that allowed them to build a narrative for publication, but I was left with seventeen proteins from different pathways and systems that seemed disconnected and unrelated. However, my circumlocutionary instincts began to process the information. I asked myself what would happen if I investigated each protein individually in the literature for connections to cancer. What I found astounded me. Through my literature search, I was able to link every individual protein to at least one hallmark or characteristic behavior of cancer. By examining the individual pieces, I was able to assemble a narrative that highlighted exactly how each of the proteins identified by the data could mark the presence of cancer within a patient. My ability to pick apart challenges and analyze them from different angles developed by my Spanish education undoubtedly contributed to my success in this scenario and the many other similar laboratory successes that followed.

Circumlocution in Scientific Communication

Circumlocution provides me just as much support when it comes to communicating my scientific results as it does while I am in the lab. Scientific communication for general audiences can be a difficult practice due to the extensive lexicon filled with jargon and technical terminology constructed by the scientific community. While this language is helpful for specialists that recognize the nuance and complexity that the specific vernacular imparts in the scientific context, general audiences often cannot interpret the scientific language produced in academic papers. In a sense, those general audiences might as well be reading a foreign language they do not know. Thus, sharing

scientific results and discoveries with the general public also requires a translation, not across languages, but across cultures.

My senior thesis relies heavily on circumlocution. As I translate my biochemical results into Spanish, I am doing so with the intention of writing for the general public. Translating for a public audience requires the explanation or the removal of all the technical vocabulary present in the work. In either scenario, explanation or removal, circumlocution aids in the process.

When describing a technical term in my Spanish translation, I take great care to further expand upon the concept. As the scientific authors I analyze in my thesis demonstrate, analogies are a great way to achieve accessible explanations. Analogies work because they provide something tangible—like the alligator and the sword-pencil—for readers to imagine as I explain concepts central to my research. An example of an analogy at work in my comp is my use of restaurant menus to describe the difference between synthetic and natural antibiotics. A natural antibiotic is a dish that is ordered without any substitutions; another lifeform has generated the molecule, and humans have adapted it for use as a pharmaceutical drug. Synthetic antibiotics, however, have either had substitutions made such as requesting a salad instead of fries with your burger, or have been built from scratch using a create-your-own menu like you might see at a Subway or a Chipotle. These pieces of imagery are readily available for a larger audience and allow me to introduce how antibiotics are discovered while decreasing potential reader confusion. I attribute much of my creative success in analogies to my study of Spanish and the circumlocutionary practices that the language has required me to use when I do not know how to say something directly.

In a similar manner to analogies, I can completely avoid certain terminology by writing around a topic. My statistical analyses and results are a clear example of my choice to remove technical language from my translation. In my translation, I do not mention the specific statistical model I run or attempt more than a basic explanation of how the analysis works. Instead, I provide broader, more general conversation surrounding the results, allowing the readers to see the take-home messages without wading through dense sections of numbers, statistical values, and technically advanced writing. I find I am able to take a step back from my results and see the larger picture, as communicating in Spanish regularly encourages me to do. When I recognize I am going to hit a proverbial wall when speaking in Spanish, I take that step back and consider different approaches to say the same thing. Language has many pathways to the same answer, but it can take the necessity of taking a different path to train a mind to see those options. That training opens up the mental roads that lead me to broader discussions of my scientific findings for the public.

Conclusion

I owe a large portion of my scientific success and thought process to the circumlocutionary thinking developed by my Spanish education. My second language training has provided me with greater perspectives, heightened levels of problem solving, and a greater capability to express myself and my ideas. Each of these skills contributes to my scientific endeavors by opening my mind to unseen solutions, strengthening my level of perseverance, and restructuring my understanding of communication across cultures and languages. Without Spanish, I would struggle to think outside the lines. Without Spanish, I would not have the patience for lab work. Without Spanish, I would

not be able to communicate with the grace and confidence I now possess. Without Spanish, I would not be half the scientist I am today.

References

"Circumlocution." *Merriam-Webster Dictionary*. https://www.merriam-webster.com/dictionary/circumlocution. Accessed 7 Apr. 2026.

About the Authors

Sam Ault graduated in December 2025 with a double major in Philosophy and Community and Justice Studies with minors in Education Studies and Global Health Studies. His work considers philosophical principles in action in contexts such as schools, healthcare, and social movements.

Alanna Blose has always approached the world with curiosity and a desire to look beyond just the surface. Rather than accepting things as they appear, she is driven to question, analyze, and uncover deeper meaning. This mindset has molded both her academic journey and her career aspirations. Currently a Global Health major with a minor in Political Science at Allegheny College, Alanna is passionate about understanding complex social and health systems and the ways they intersect with policy and global inequities. Her interests are rooted in making a meaningful impact and seeking solutions that address symptoms and underlying causes. Writing has always been a constant in her life. It serves as both an instrument for critical thinking and a way to express, explore, and challenge ideas. No matter where her career leads, she will continue to carry writing with her closely, as a means of reflection, advocacy, and change.

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Samuel Roque is a spring 2026 graduate with a double major in computer science and theatre with a minor in dance and movement studies originally from Yonkers, NY. Samuel played as part of the offensive line in football, was a member of the Honor Committee, served as as a production technician for the Playshop Theatre and was involved in USITT (United States Institute for Theatre Technology).

Nickel Spartz is a spring 2026 graduate with a bachelor of science in biochemistry and Spanish. They have many academic interests that include biochemical microbiology, scientific communication, translation, creative writing across the curriculum, and acting performance. Nickel will begin a masters of biochemistry at the University of Copenhagen in September 2026.

Jonah Wells is a spring 2026 graduate from just outside Philadelphia, Pennsylvania. At Allegheny, he majored in physics with a minor in economics. He competed as a member of the track & field team and served as president of his fraternity in 2025. After graduation, he will attend Carnegie Mellon University to pursue a PhD in physics.

Reagan Grace Wheat is a spring 2026 graduate with a double major in Political Science and Women's, Gender, and Sexuality Studies. Reagan Grace was a founding member of the Allegheny Chapter of Triota (Iota Iota Iota), the honor society for Women's, Gender, and Sexuality Studies. She will be working in a public defender's office after graduation.